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INSTRUCTION MANUAL

MODEL 102

3 MC PULSE GENERATOR

RETURN TO
AEROSPACE

DATAPULSE

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INSTRUCTION MANUAL

MODEL 102

3 MC PULSE GENERATOR

RETURN TO
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Model 102 Pulse Generator provides wide versatility in repetition rate, delay, pulse width, amplitude and pulse shape control. Vernier control of pulse is realized through the use of a 1, 2, 5 range switching arrangement. The vernier control fills in from 1 to 2, or from 2 to 5, or from 5 to 10 in a decade switching pattern to give high resolution, but convenient switching.

Regulated power supplies insure low jitter and amplitude stability. Electronic overload protection for the output pulse automatically limits the output pulse amplitude.

This instrument is ideal for the advanced laboratory, and for production line or other testing operations.

This manual contains general and detailed instructions for use and maintenance of your DATAPULSE Model 102 Pulse Generator. A complete understanding of its contents will contribute greatly to full utilization of the broad capabilities of this instrument.

DATAPULSE INCORPORATED
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Inglewood, California
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PROCEDURES
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SECTION I

SPECIFICATIONS

1.1 REPETITION RATE

Continuously variable from 2 cps to 3 mc covered in 19 steps (1, 2, 5 series) plus uncalibrated vernier. Step accuracy is 10% nominal (15% max.), with vernier at min, stability* is typically ± 1 1/2%, jitter is typically .08%.

1.2 EXTERNAL TRIGGER

Standard unit requires 15v pos. pulse with less than 2 μs rise time at 0 to 3 mc, 20v rms sine wave at 200 cps to 1 mc. When specified with Option T, requires pos. pulse of at least 50 ns duration and 5v amplitude (7 volts above 1 mc) with rise time less than 4 ns per volt (or pos. 15v pulse of 20 ns duration). The Sync Output occurs approx. coincident with the leading edge of an external trigger.

1.3 SINGLE PULSE

Operation of a front panel pushbutton provides one cycle of output.

1.4 MAIN PULSE DELAY (of leading edge from Sync Output)

Continuously variable from approx. 0.2 μs max. to 10 ms, covered in 14 steps (1, 2, 5 series) plus uncalibrated vernier, at least 70% max. duty cycle below 2 mc rep. rate.

1.5 MAIN PULSE DURATION

Continuously variable from 50 ns to 10 ms, covered in 14 steps (1, 2, 5 series) plus uncalibrated vernier.

1.6 STABILITY, JITTER, ACCURACY (Delay & Duration)

Stability* is typically ± 2 1/2%. Jitter is typically 0.05% + 2 ns. Step control accuracy is ± 10% nominal (15% max. at duty cycles to less than 50%).

1.7 MAIN PULSE OUTPUT

Selectable pos., zero, or neg., dc coupled, 50 ohms nominal source impedance.

1.7.1 Amplitude

At least 50v peak into 50 ohms (approx. +70v, -125v open circuit). Provides at least 15v into 10 ohms (1.5 amperes peak) at duty cycles to 4%. Stability* is approx. ± 5% max. For pulses up to 3 μs duration, provides at least 100v into 200 ohms when used with Type 2102 impedance matching transformer.

1.7.2 Baseline DC Level (With 50 Ohm Load)

Nominally at less than 500 mv (1v max.) on pos. pulse, less than 50 mv (100 mv max.) on neg. pulse, attenuated according to attenuator control setting. See Model 102A data and Applications Bulletin No. 102-4 if other levels are required.

1.7.3 Attenuation

Continuously variable zero to 60 db (approx. 10% accuracy), covered in 10-db steps, 2-db steps, and uncalibrated vernier.

1.7.4 Waveform (Into 50 Ohm Resistive Load, Measured on Sampling Oscilloscope - See also Applications Bulletin No. 1000-1)

Rise time (leading edge) is continuously variable from nominally 10 ns to 0.5 μs. Fall time (trailing edge) is slightly greater than rise time. Overshoot (less than 15 ns in duration) is less than 4% of nominal amplitude at rise times of 13 ns and greater at less than 30 db attenuation. Top slope may be adjusted to flat within 3% of nominal amplitude at any pulse width up to 1 ms (less than 10% droop at 10 ms).

1.7.5 Duty Cycle and Overload Protection

Average output stage current in excess of 225 ma (approx. 20% duty cycle) automatically operates a panel indicator lamp and activates protection circuits to partially disable output. Removal of overload automatically returns circuit to normal. The unit may be adjusted (internal screwdriver adjustments per Application Bulletin No. 102-1) to provide reduced amplitude output at duty cycles to 70% (50% above 1 mc), generating at least 15v peak into 50 ohms at 50% duty cycle.

1.8 SYNC OUTPUT

Pos. 20v pulse from approx. 100 ohms, approx. 0.1 μs duration, ac coupled.

1.9 POWER SUPPLIES

All dc power supplies, including output stage plate supply, are fully regulated for stable operation under varying conditions of load or line voltage.

1.10 POWER REQUIRED

105-125v, 50/60 cycle, ac, approx. 500 w max. Operation at 220v and 50/60 cycles may be specified at no added cost.

1.11 CONSTRUCTION

Clear anodized aluminum panel with etched black and red markings, beige cabinet with quick-release top and bottom covers, forced air cooling with filter, BNC connectors.

*Stability is stated as typical change with line voltage variation of ± 10v around 115v.

1.12 SIZE AND WEIGHT

8 3/4" h x 17" w x 15 1/4" d. May be rack mounted (8 3/4" h x 19" w panel space) by specifying Model 102R or by removing handles and cabinet covers and installing Type 1002 set of rack mounting brackets and dust covers.

1.13 ACCESSORIES FURNISHED

One operation and maintenance manual, 8 ft. line cord with NEMA 3-prong plug.

1.14 ACCESSORIES AVAILABLE

Extra instruction manual copies; 50-ohm power termination (Type 2002); inverting pulse transformer (Type 2101) for external triggering from neg. pulses or providing neg. Sync Output; impedance matching transformer (Type 2102) for generating 100v amplitude pulses; 60 db external attenuator (Type 2450); rack mounting set (Type 1002); UHF and BNC 50-ohm coaxial cables.

SECTION II

OPERATING INSTRUCTIONS

2.1 DESCRIPTION OF CONTROLS AND CONNECTORS

See Figure 2-1

2.1.1 Power On

Connects or disconnects ac input voltage to transformer primaries within instrument.

2.1.2 Pilot

Indicates when power is applied to instrument.

2.1.3 Repetition Rate

A 20-position switch which sets the values of R and C in the oscillator to determine pulse repetition frequency. One position is provided for external triggering.

2.1.4 Repetition Rate-Vernier

A potentiometer mounted concentric with repetition rate switch provides an uncalibrated fill in control between positions of repetition rate switch.

2.1.5 Single Pulse

A momentary contact push button which initiates one cycle of output, when repetition rate switch is in EXT. position.

2.1.6 Pos. External Trigger Input

BNC connector accepts 20v rms sine wave or +15v pulse with 2 μs rise from zero to 3 mc to externally drive the oscillator when repetition rate switch is in the EXT. position.

2.1.7 Positive Sync Output

BNC connector couples a 20v positive sync pulse which provides a "zero" time reference for the delay circuit.

2.1.8 Pulse Delay

A 14 position switch which sets the values of R and C in the delay circuit to determine pulse delay.

2.1.9 Pulse Delay-Vernier

A potentiometer mounted concentric with pulse delay switch, which provides an uncalibrated fill-in between positions of the pulse delay switch.

2.1.10 Pulse Width

A 14 position switch which sets the values of R and C in the width circuits to determine pulse width.

2.1.11 Pulse Width-Vernier

A potentiometer mounted concentric with pulse width switch, which provides an uncalibrated fill-in between steps of the pulse width switch.

2.1.12 Polarity

A 3-position switch which selects positive, negative or zero output.

2.1.13 Rise Time

A potentionmeter, mounted concentric with the polarity switch, which varies the rise time of the output pulse.

2.1.14 Attenuation (0-10 db)

A 6-position switch which selects 0 to 10 db of attenuation in steps of 2 db.

2.1.15 Attenuator-Vernier (0-10 db)

A potentiometer, mounted concentric with 0-10 db attenuator, which provides an uncalibrated fill-in between steps of the 0-10 db attenuator.

2.1.16 Attenuation (0-50 db)

A 6-position switch which selects 0-50 db of attenuation in steps of 10 db.

2.1.17 Pulse Output Connector

UHF connector couples variable parameter pulse to external load.

2.1.18 Average Pulse Current Overload

Red indicator light indicates when maximum average current limitation has been exceeded and overload protection circuit is in operation.

2.1.19 Fuse (Located on Rear Panel)

A 5-amp, fast blow fuse protects instrument against ac overload.

2.1.20 Power Input (Located on Rear Panel)

3-prong male connector connects instrument to ac line through NEMA 3-wire line cord.

2.2 PLACING IN OPERATION

Set pulse repetition rate switch to 1 kc and vernier fully ccw.
Set pulse delay switch to 0.5 μs; vernier cw.
Set pulse width switch to 0.5 μs; vernier cw.
Set polarity switch to "+ ".
Set rise time control ccw.
Terminate output pulse into 50 ohms.
Set power switch to ON. (Pilot light should indicate that power is on)
Sync oscilloscope from positive sync output with sweep speed at 0.5 μs/cm and vertical sensitivity at 20v/cm.
View output pulse and verify presence of same.
Allow instrument to warm up 1/2 hour before operating.

Figure 2-1. Front Panel Controls.

2.3 OPERATING CONSIDERATIONS

2.3.1 Single Pulse Operation

Place REPETITION RATE control on EXT. prior to depressing button. Maximum single pulse rate is one per second.

2.3.2 External Triggering

REPETITION RATE control must be on EXT. Maximum repetition rate is 3 mc.

2.3.3 Delay Duty Cycle

Delay circuits may fail at PULSE DELAY control settings greater than 70% of the main pulse period.

2.3.4 Width Duty Cycle

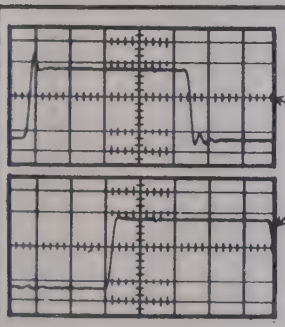
Pulse width circuits may fail at PULSE WIDTH control settings greater than 70% of the main pulse period. Also, any combination of pulse width and PRF which causes delivery of over 300 ma to the external load and/or to the internal attenuator will cause the power supply to current-limit at this level. This condition is signaled by the AVERAGE PULSE CURRENT OVERLOAD indicator. It does not damage the instrument to operate indefinitely in this mode; however, the output pulse amplitude will be markedly unstable.

2.3.5 Overshoot

The RISE TIME control may be used to trim out overshoot and optimize waveform.

2.3.6 Cooling

The bottom dust cover must be in place to provide adequate cooling. Maintain a clearance of at least three inches at the back of the rear air intake, and be sure to clean the air filter at regular intervals.



From Tektronix 541 with vert. deflection 20v/cm and sweep speed 0.1μs/cm

Figure 2-2. Pos. Pulse Connected to Scope with 4' RG-58A/U, Terminated in 50Ω at Generator.

Figure 2-3. Pos. Pulse where POS. SYNC OUTPUT is Connected to Scope with a Clip Lead. Notice baseline preceding the Pulse.

2.3.7 Pulse Top Saturation Oscillations

Because of the limited cathode emission of the output tubes the output pulse amplitude will vary somewhat as a function of pulse width duty cycle. For this reason the top of the pulse may be below, on the threshold, or well into the saturation region of the output tubes as a function of duty cycle.

When the pulse top is at the saturation threshold it is unstable and oscillations occur. Turning in about 1/2 db of attenuation on the ATTENUATION VERNIER will suppress this effect.

2.3.8 Cabling Considerations

Delivery of clean waveforms can be assured if good cabling practices are observed. The sync pulse should be connected to the scope and/or the system under test with 93 ohm coaxial cable. This line should be terminated into 93 ohms at the scope. The main pulse should be connected to the load via a 50 ohm coaxial cable and terminated into 50 ohms at the load.

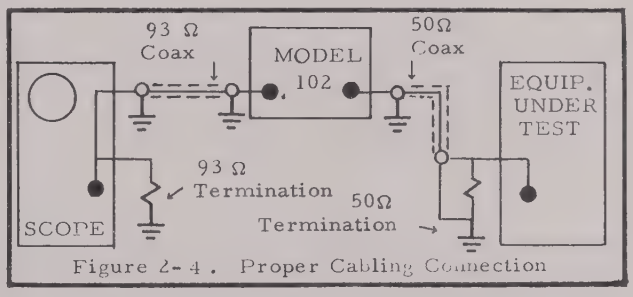


Figure 2-4. Proper Cabling Connection

2.4 SPECIAL APPLICATIONS

2.4.1 Positive Sync Pulse Output Polarity Inversion

Some applications require negative polarity sync pulses which are not normally available in the Model 102. DATAPULSE Model 2101 Trigger Pulse Inverting Transformer, available as an accessory was designed to permit inversion of sync pulses.

2.4.2 Negative Pulse External Triggering

DATAPULSE Model 2101 Trigger Pulse Inverting Transformer, discussed above, may also be used to invert negative trigger pulses which may then be applied to the POS. EXTERNAL TRIGGER INPUT of the Model 102.

2.4.3 Further Applications

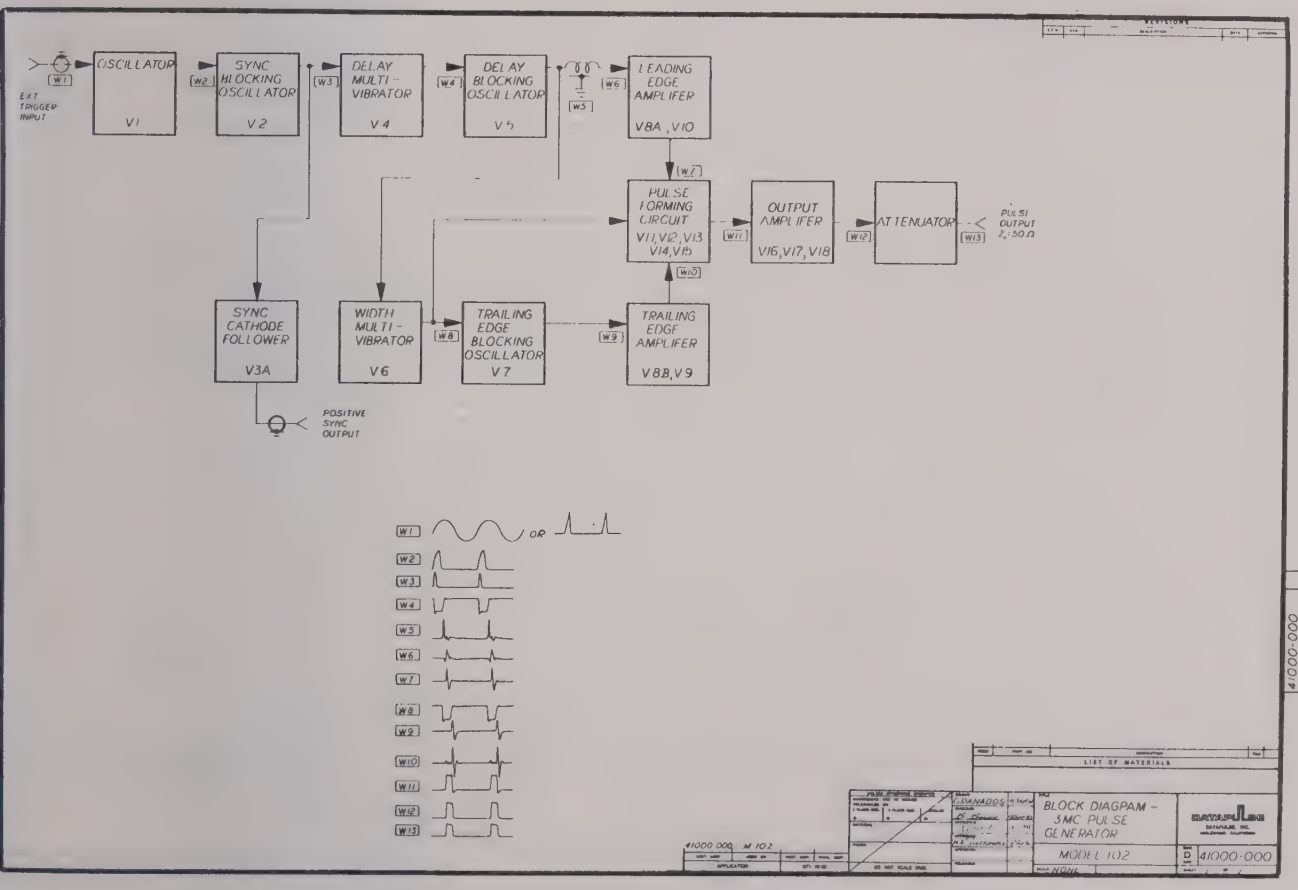
For further applications and service information, refer to the Application & Services Bulletin in the rear of this manual.

SECTION III

THEORY OF OPERATION

3.1 BLOCK DIAGRAM DESCRIPTION

A pulse repetition rate (W2) variable between 2 cps and 3 mc is determined by either the internal oscillator or an external drive. The output of the Oscillator (W1) is used to trigger the Sync Blocking Oscillator which provides a "Zero" time reference pulse (W3). This pulse is coupled out (in the Sync Cathode Follower) as a sync pulse and is used to trigger the Delay Multivibrator. The gate from this MV is differentiated and the trailing edge portion is used to trigger the Delay Blocking Oscillator. The output from the Delay BO (W5) is used to trigger the Width MV and is also delayed (0.09 μs) to become the leading edge trigger (W6) which is amplified by the Leading Edge Amplifier. The width gate (W8) is differentiated and used to trigger the Trailing Edge BO, which is amplified by the Trailing Edge Amplifier. Using the leading and trailing edge triggers (W7) and (W10) in conjunction with the duration gate (W8), a fast rise and fall pulse is formed. This pulse (W11) is cathode-follower coupled to the output amplifiers where it is transformed into a heavy current pulse (W12) which is applied to the attenuator and attenuated to the level desired to give the output pulse (W13).



3.2 ASTABLE SCHMITT TRIGGER

The Astable Schmitt trigger circuit differs from a normal Schmitt trigger in that the changing network C_t and R_t (see Figure 3-1) produces a controlled positive going waveform on the grid (pin 2) of the trigger tube. This circuit functions as follows: V1B conducts heavily because of the bias imposed upon it by R6, R7, and R10 between B+ and B-. The current of V1B flows through R_k causing a large voltage drop which appears as a positive potential at the common cathode pins 3 and 8. As the grid (pin 2) of V1A is around ground, V1A is cut off by the positive potential at its cathode (pin 3). At a time (t), C_t begins to charge through R_t toward B+. This charge continues until time (t2) when the grid-to-cathode-voltage of V1A is small enough to allow conduction. As V1A conducts, its plate (pin 1) dips sharply because of current flowing through R6 (15k). This negative going potential is coupled across R7 (22k) and C3 (27 μμf) to the grid of V1B (pin 7). The conduction of V1B now decreases, decreasing the cathode potential of V1A causing V1A to conduct harder and thus regeneratively saturate itself and cut off V1B.

Because R6 is 15k and R8 only 1k, much less current flows through R_k as V1B cuts off and its cathode potential approaches ground. The grid of V1A (pin 2) follows the cathode down, discharging C_t through grid current. At a time (t3), a point around ground is reached where the cathode to grid potential is low enough for V1B to conduct. An attendant increase of current through R_k causes a higher potential at the cathode of V1A (pin 3). As V1A decreases conduction and its plate (pin 1) becomes more positive, this waveform coupled across R7 and C3 to the grid of V1B (pin 7) causes V1B to conduct harder with an attendant increase of current through R_k which regeneratively saturates V1B and cuts off V1A. C_t now begins to charge through R_t toward B+ and the cycle is repeated.

The output of this circuit is taken from the plate of V1B (pin 6) and is used to trigger the Sync Blocking Oscillator (V2).

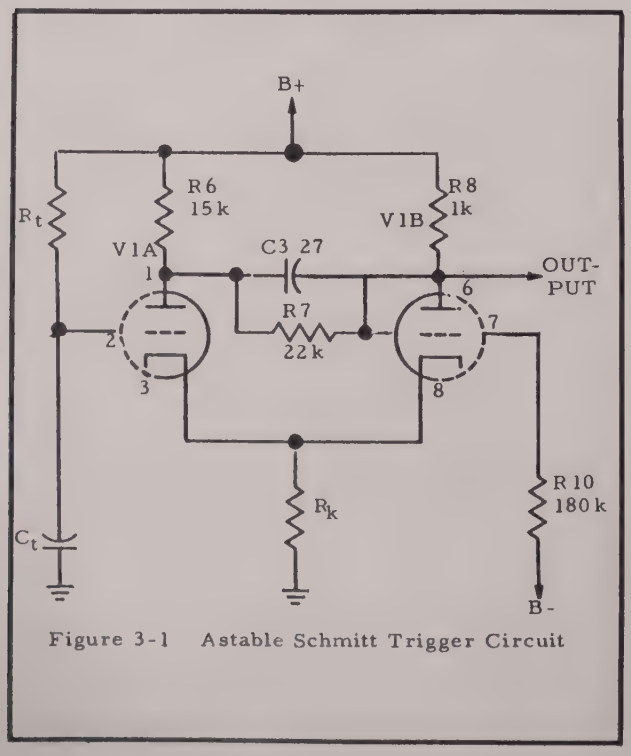


Figure 3-1 Astable Schmitt Trigger Circuit

3.3 BLOCKING OSCILLATOR

The Sync Blocking oscillator is typical of the Delay BO and Trailing Edge BO (see Figure 3-2) and operates as follows:

Initially both sides of the tube are cut off because of grid bias returns.

When a positive pulse arrives at the grid (pin 2) of the left-hand section, conduction is initiated driving both plates negative. Due to the polarity of the transformer a negative pulse upon the plates appears as a positive pulse upon the grid (pin 7) of the right-hand side of the tube causing this tube to conduct. This added current drives the plate more negative which in turn reinforces the signal at the grid until the plate (pin 6) of the right-hand section is driven into saturation. At this point the gain from grid to plate becomes less than one and the process reverses itself driving the tube into cut off which completes the cycle. The output of this circuit is taken off the cathode (pin 8) of the right-hand side across R_k.

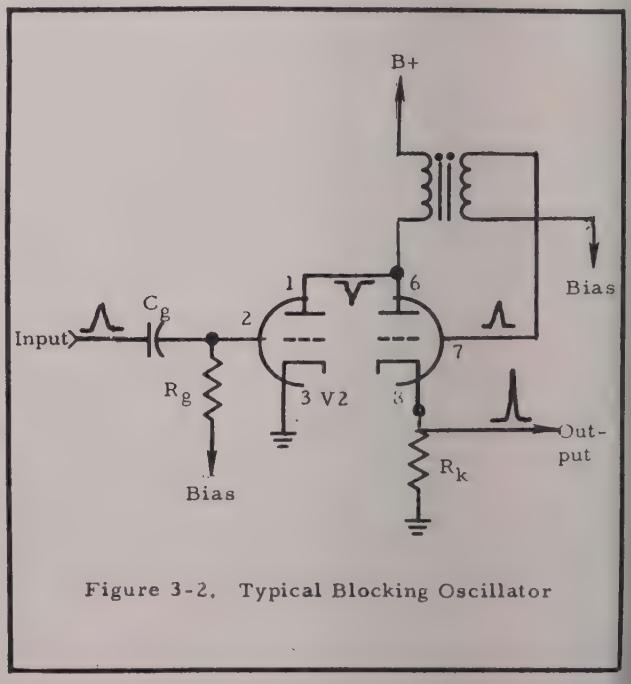


Figure 3-2. Typical Blocking Oscillator

3.4 THE ONE-SHOT MULTIVIBRATOR

Pulse delay circuitry is a cathode coupled one shot multivibrator (see Figure 3-3). Since pulse width generation is essentially a delay function, (i.e., the delay of trailing edge with respect to leading edge) the same technique is used to perform both operations. For this reason only delay shall be discussed.

In the quiescent state, V4B is cut off because of the bias imposed upon its grid (pin 7) by the voltage divider composed of R19, R20, R25 and R28. V4A is conducting because of its positive grid return through Rt. As the plate load R19 is great (100k with respect to R_k, the common cathodes of V4A and V4B are at a potential around ground. At time (t0) a positive input trigger causes V4B to conduct and because of the low impedance (470) in the plate of V4B (pin 6) a large current flows through R_k causing the cathode of V4A (pin 3) to become sufficiently positive to cut off V4A. As the plate (pin 1) of V4A becomes more positive, because of decreased current flow, this waveform is coupled across C9-R20 and C11-R25 to the grid of V4B causing more current to flow, regeneratively saturating V4B. As soon as the cathode of V4A (pin 3) becomes more positive than its grid (pin 2) C_t begins to charge through R5. This charge continues until a point is reached at time (t2) when the grid of V4A (pin 2) is sufficiently positive to allow V2B to again conduct driving its plate (pin 1) negative. This negative waveform coupled across C9-R20 and C11-R25 to the grid of V4B (pin 7) causes conduction of V4B to decrease, forcing the cathode of V4A less positive and increasing conduction, regeneratively saturating V4A and cutting off V4B. The cathodes of V4A and V4B return to their quiescent state and the grid of V4A follows the cathodes down as grid current discharges C_t completing the cycle.

The trailing edge of the negative gate at the plate of V4B (pin 6) is differentiated and used to trigger the delay blocking oscillator. In the case of pulse width, this gate becomes the duration gate.

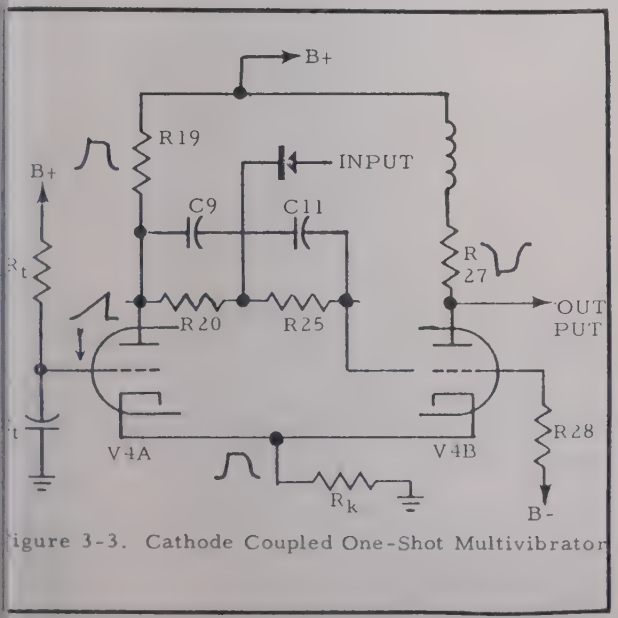


Figure 3-3. Cathode Coupled One-Shot Multivibrator

3.5 TRANSFORMER COUPLED AMPLIFIER

Initially the tube is cut off because of bias return. As a positive pulse is applied to the grid, the plate conducts heavily and goes negative. The polarity of the transformer is such that a negative charge upon the plate provides a positive going signal to the grid of the next tube. R_p is used to damp the secondary of the transformer to prevent oscillations. Pulse narrowing takes place (see Figure 3-4) as each preceding tube only conducts as the pulse is above the cutoff point thus eliminating the time from base line to approximately 85% amplitude point.

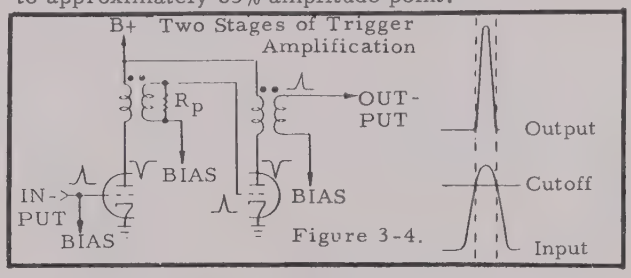


Figure 3-4.

3.6 PULSE FORMING CIRCUITS

V14 is normally conducting because of its positive grid return (see Figure 3-5). Its plate (pin 5) sets slightly above ground. The negative duration gate applied at its grid (pin 1) cuts off V14 and its plate starts to rise at a rate governed by circuit capacity. A few nanoseconds later the leading edge trigger is applied to the "lift up diode" (V13) whose low impedance charges the capacitor rapidly causing a fast rise leading edge. The top of the pulse remains at the voltage set by the top slope control as V14 is still held off by the duration gate for the duration of the pulse. The fast rise pulse is applied to the grid (pin 2 and 7) of the cathode follower (V15), whose output drives the output amplifier section. At the end of pulse time, the gate at the grid of V14 subsides and V14 begins to conduct. Simultaneously the positive trailing edge trigger is applied to the grids (pin 2 & 7) of the trailing edge pull-down tube V12 driving its plate sharply negative discharging circuit capacity and creating a fast fall trailing edge. This fast rise and fall positive pulse is then applied to the output amplifier section. The capacitors C34 (overshoot) and C39 will provide a feedback network to trim pulse irregularities.

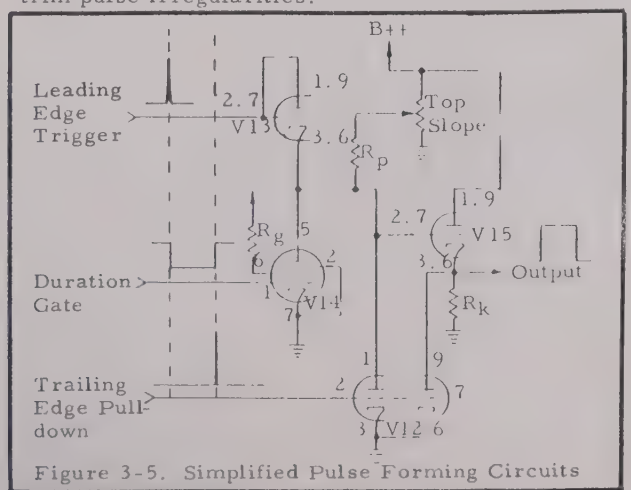


Figure 3-5. Simplified Pulse Forming Circuits

3.7 OUTPUT AMPLIFIER

The fast rise and fall pulse from V15 is coupled across C40 to the rise time control R64. Since no commutation is provided, an increase in the resistance of R64 will cause rise time to be increased in an exponential manner because of the input capacity of the output tubes V17 and V18. The output tubes are connected such that, through boot strappings, the screen to cathode voltage and hence screen to control grid voltage remains relatively constant with resultant increase in gm yielding a greater degree of wave shape preservation from input to output.

Positive output pulses are obtained from cathode followers with baseline around ground potential. As polarity is changed to negative, the output tube configuration is changed to operate the output tubes as amplifiers, with output taken at the plate. In addition, the ground reference for the power supply is switched such that the baseline remains around ground.

Bias is provided through a cathode follower whose low impedance discharges C40 effectively to prevent a bias shift with changes in duty cycle.

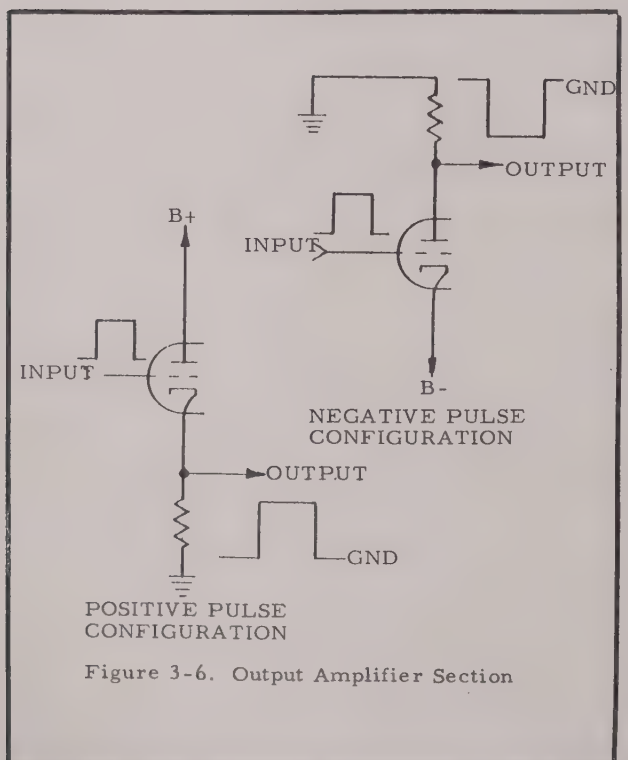


Figure 3-6. Output Amplifier Section

3.8 OVERLOAD PROTECTION CIRCUIT

An overload protection circuit is employed to insure that output current does not exceed a safe value. In the event that this limitation is inadvertently exceeded by control settings, a red warning light glows to indicate that this circuit is in operation.

Output current is sampled through R102 and T2 located in the center tap of the output voltage transformer winding. This sample is rectified by CR9 and filtered by the integrating action of V24A and appears as a dc voltage upon the control grid of V24A as current rises to a point predetermined by the setting of R135. V24A will conduct heavily enough to drop the voltage at its plate (pin 1) appreciably. This negative potential is coupled through R140 to the grid (pin 9) of V22A causing V22A to cutoff. The plate (pin 1) of V22A then rises causing a rise at the control grid (pin 2) of V22B. V22B now conducts heavily pulling down the grid of the +225 supply limiting the output of the +225 supply to approximately 150v. This lowered supply to the pulse forming circuit causes sufficient reduction of the amplitude of the output pulse to hold output current at a safe value. The plate of V24A is also coupled to the grid of V3B. As the plate of V24A drops, the grid of V3B drops cutting off V3B. Connected in parallel with V3B is an (overloading indicator) which lights as the plate of V3B goes sufficiently positive.

By setting R136, the indicator is caused to light slightly before the +225 volt supply is reduced.

Note, that as the gain of the servo loop is greater than one, the output voltage may "cycle" somewhat as the circuit is in operation. Because of this the instrument should not be operated in overload condition as erroneous readings will result.

As duty cycle is reduced and output current decreases, the circuit settles back to quiescent state and normal operation ensues.

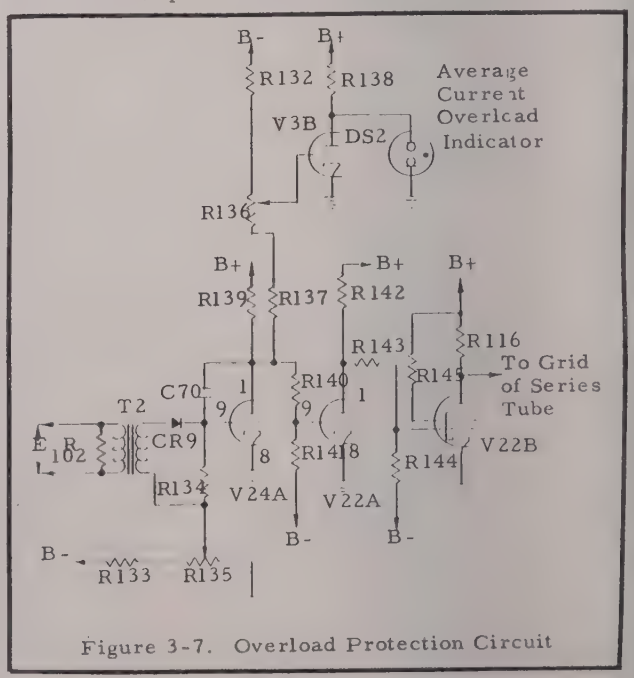


Figure 3-7. Overload Protection Circuit

SECTION IV

MAINTENANCE INSTRUCTIONS

PREVENTIVE MAINTENANCE

1.1 Preventive Inspection and Service

Regular inspection and service of a pre-
ntive nature will result in optimum performance
d longer life of this instrument. Dust covers
ould be removed at regularly scheduled intervals
permit inspection for dust, tarnish, corrosion,
ose nuts and bolts (especially those serving as
ectrical conductors), loose cables and fuses, charred
sulation, scorched resistors and broken wiring.
scoloration of the printed circuit board, due to heat,
es not affect the board's electrical properties and
ay be disregarded in most cases. This problem
ay be alleviated if the air filters are cleaned fre-
ently and thoroughly as described below.

1.2 Filter Cleaning

The instrument is cooled by air drawn into
e interior through a washable aluminum-mesh, ad-
sive coated filter. When dirty, the filter will re-
rict the flow of cooling air and cause overheating.
clean the filter, first rap it gently on a hard sur-
ce to remove loose dirt. Then wash the filter with
t water and soap. DO NOT USE CAUSTICS. After
nsing and drying, dip or spray the filter with an
proved adhesive, such as FILTER-COAT manufac-
red by the Research Products Corporation of
adison, Wisconsin.

1.3 Fan Motor Lubrication

The fan motor should be lubricated at
gular intervals with a few drops of light machine
l.

1.4 Minor Repairs

The operator should be thoroughly ac-
ainted with the instrument's circuit theory and
mponent location before attempting repair. In all
ses, setting and adjustment of controls should be
ecked in order to verify that difficulties encountered
e actually caused by malfunction and not by oper-
ion outside of specifications. Check tubes and
ansistors in suspected circuits prior to conducting
tensive tests on other components. A check of
e important waveforms brought out to the front
nel will be of great assistance.

1.5 Recalibration

This instrument was designed to provide
aximum reliability and stability. To insure that
curacy remains within stated limits, we suggest
at calibration be checked after every 200 hours of
eration. If the unit is used intermittently, cali-
ration should be checked every three months. Com-
ete instructions for calibration are given in this
anual.

4.2 PARTS REMOVAL AND REPLACEMENT

4.2.1 General

This instrument is sturdily built and easily accessible. Removal of most parts is so simple that explanations are unnecessary. However, some parts are more easily removed if a definite procedure is followed. Replacement of some parts will also require partial recalibration. Refer to Section 4.3 of this manual for calibration instructions.

4.2.2 Replacement of Switches

The output amplifier switches may be ordered from DATAPULSE as single sections or as unwired assemblies. If a single wafer on the oscillator, delay, or width switch is defective, the entire switch must be replaced. These are available from our factory either wired or unwired.

The capacitors mounted to these switches are matched sets. Should a capacitor require replacing, its entire set (as indicated on the schematic) must be replaced with a new matched set. These matched condenser sets are available from DATAPULSE. Recalibration is required if the switches or the condenser are replaced.

4.2.3 Replacing Tubes

Tubes should not be replaced unless they are actually causing trouble. Unnecessary replacement only necessitates recalibration. Tubes removed for maintenance reasons should be returned to the socket from which they were removed unless found to be defective. When replacement is necessary, only high quality tubes should be used.

4.2.4 Soldering Considerations

Although printed wiring is quite vulnerable to heat excesses, a great deal of resoldering can be done on a single joint if care is taken. A 35 watt wedge tip or pointed tip iron and 60-40 rosin core solder are quite effective. Where both sides of the board are accessible apply the tip of the iron (on the side opposite the component) directly to the solder fillet and pull gently on the pigtail with pliers from the opposite side. Where both sides of the circuit board are not accessible, the component lead will be fed through the board through an eyelet. Apply the iron tip to the eyelet and pull the pigtail out with the pliers. To insert a new component, clean out the hole with a sharp object (it may be necessary to apply more heat) and insert the new component, soldering in the old place.

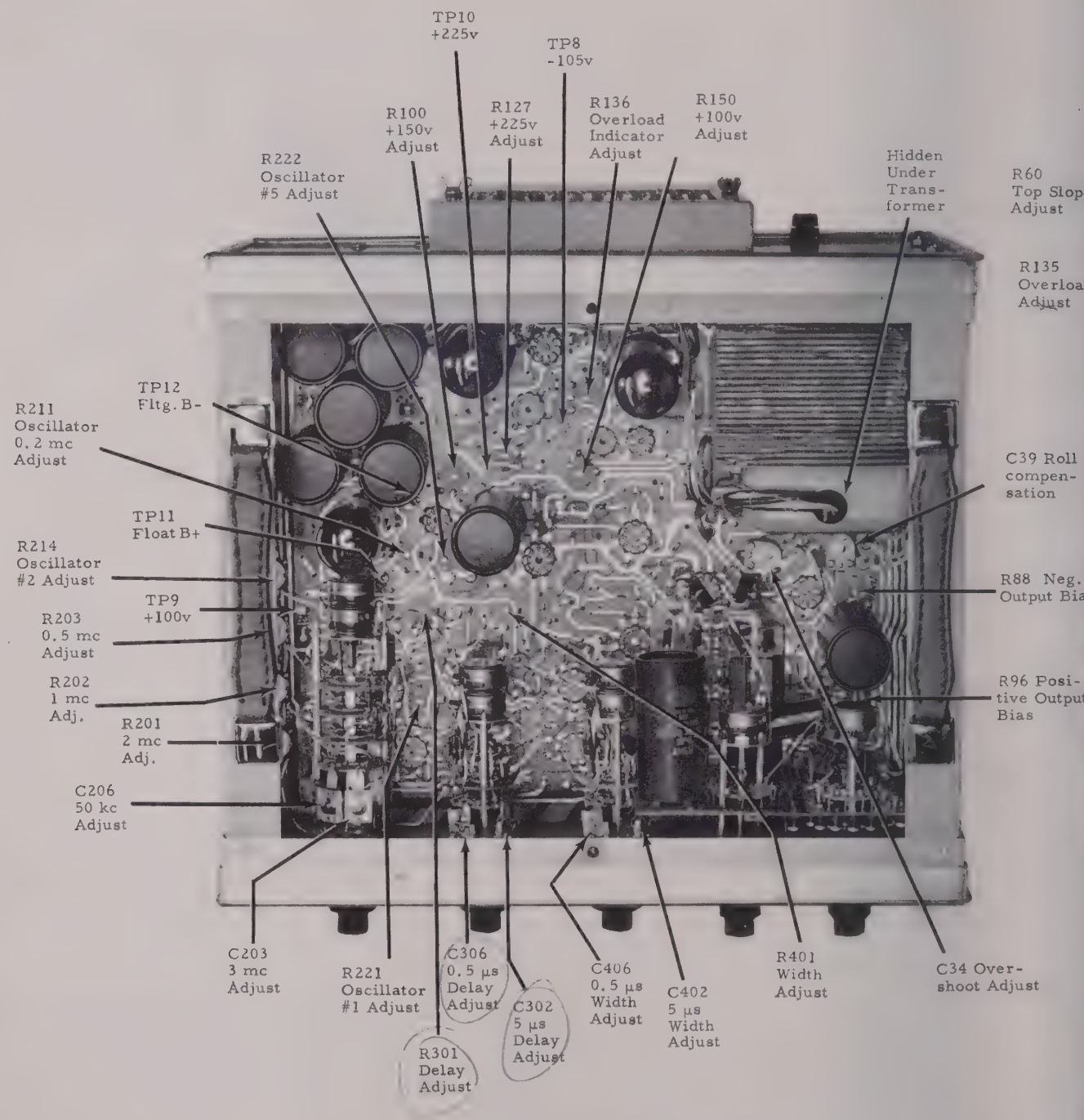


FIGURE 4-1 MODEL 102 VOLTAGE
TEST POINTS AND CALIBRATION ADJUSTMENTS

4.3 CALIBRATION PROCEDURE

Prior to attempting calibration, check control settings, check for proper operation and allow the instrument to warm-up for 1/2 hour. Assemble the following.

a. A general purpose 30 mc oscilloscope (TEKTRONIX 543 or equivalent including type "L" high gain preamplifier and Type "N" sampling plug-in or equivalent.)

b. A dc voltmeter (SIMPSON 260 or equivalent). (If overload circuit is to be calibrated, two will be required.)

c. An insulated low capacity screwdriver.

d. A variable ac source (POWERSTAT Model 116 or equivalent).

e. A 50-ohm external termination (DATAPULSE Model 1002 or equivalent).

f. A 500 kc signal generator (HEWLETT-PACKARD 233A or equivalent).

g. If overload circuit is to be calibrated, a tube socket adapter (VECTOR T80C) will be required.

4.3.1 Power Supply Calibration

NOTE:

As the timing circuits are dependent upon the regulated power supply voltages for reference, any variance of these voltages will necessarily cause a change in calibration accuracy. Therefore, these adjustments should not be attempted unless one is prepared to carry out complete recalibration.

If power supply voltages are found to vary considerably from specified voltage, temporary readjustment may be made; however, bear in mind that measurements made may not be accurate until the instrument has been recalibrated. If any portion of the instrument fails to calibrate, repair should be effected before attempting to complete calibration.

4.3.1.1 -105v (B-) Supply

This voltage is determined within approximately ± 10% of -105v and regulated by a gas tube (OB2) and no adjustment is provided. This voltage is used as a reference for the +100v and the +225v power supplies and should, therefore, be checked prior to adjustment of these supplies.

Connect a dc voltmeter from tp8 (-105v) to ground. Vary line voltage with variac ± 10% from 115v ac and verify regulation.

4.3.1.2 +110v (B+) Supply

a. Connect dc voltmeter from tp9 (+110v) to ground. Adjust R130 (+100v adjust) for a reading of 110v.

b. Vary line voltage ± 10% around 115v and observe that power supply variation is less than ± 2v.

c. Remove voltmeter and connect a high gain oscilloscope from tp9 to ground. Observe that ripple is approximately 50 mv with pulse repetition rate switch on EXT.*

4.3.1.3 +225v Supply

a. Connect dc voltmeter from TP10 (225v) to ground. Adjust R127 (+225v adjust) for a reading of 225v.

b. Vary line voltage ± 10% around 115v and observe that power supply variation is less than ± 5v.

c. Remove voltmeter and connect a high gain oscilloscope from TP10 to ground. Observe that ripple is approximately 50 mv with pulse repetition rate switch on EXT.*

4.3.1.4 +150 (Floating) Supply

a. Set pulse REPETITION RATE switch on EXT. Set POLARITY switch in "+" position.

b. Connect dc voltmeter from TP11 to ground and adjust R100 (+150v adjust) for a reading of 150v.

c. Vary line voltage ± 10% around 115v and observe that power supply variation is less than ±5v.

d. Remove voltmeter and connect a high gain oscilloscope from TP11 to ground. Observe that ripple is approximately 50 mv.*

4.3.1.5 Bias

a. Place dc voltmeter from junction of CR22 and C54 to ground. Reading should be -18v, +30%-0%.

b. Place dc voltmeter from junction of R110 and R111 to ground. See that reading is between 5.1 and 6.2v. Vary line voltage ± 10% around 115v. See that reading does not vary more than 1%.

*NOTE: This is not a specification, but merely a check on power supply performance and should be compared with previous checks only. Ripple increases over previous readings are a sign that the 6AS7 series tube is weak.

4.3.2 Repetition Rate Calibration

NOTE:

As calibration accuracy on most oscilloscopes is in the range of ±5%, the ultimate calibration accuracy of the instrument is limited by this value, i.e.; if the instrument is calibrated using an oscilloscope which is 5% off in one direction and is then checked with another which is 5% off in the opposite direction, a 10% deviation will be shown. If calibration is performed using a frequency meter type of counter such as Hewlett-Packard Model 5243, driving the counter with the sync pulse, calibration accuracies of ±5% from 2 cps to 100 kc and ±1% above 100 kc can usually be obtained. However, if output is then viewed on a ±5% oscilloscope, these accuracies may then be viewed as ±10% and ±6% respectively.

a. Set REPETITION RATE control to 2 kc, vernier fully ccw.
Set PULSE DELAY control to 0.5 microsec, vernier fully ccw.
Set PULSE WIDTH control to 0.5 microsec, vernier fully cw.
Set POLARITY to "+", attenuator controls fully cw, rise time fully ccw, terminate pulse output into 50 ohm load (DP Part No. 1002).

b. View output pulse on calibrated sweep oscilloscope.

c. Adjust R214, "2" adjust for 0.5 millisecond pulse spacing (2kc/s).

d. Set REPETITION RATE control to 5 kc. Adjust R222, "5" adjust for a pulse spacing of 0.2 millisecond (5kc/s).

e. Set REPETITION RATE control to 10 kc. Adjust R221, "10" adjust for a pulse spacing of 0.1 millisecond (10 kc/s).

f. Check all ranges from 2 cps to 10 kc/s and insure that they are within ± 10%.

g. Set REPETITION RATE control for 50 kc. Adjust C206, 50 kc adjust for a pulse spacing of 20 microsec, (50 kc/s). Check 20 kc/s and 0.1 mc ranges and insure that they are within ± 10%.

h. Set PULSE WIDTH VERNIER fully ccw. Set REPETITION RATE control to 2 mc, VERNIER fully cw. Adjust C203, 3 mc adjust for a pulse spacing of 0.33 μs (3 mc).

i. Set VERNIER fully ccw. Adjust R201, 2 mc adjust for a pulse spacing of 0.5 μs (2mc).

j. Set REPETITION RATE control to 0.2 mc adjust for a pulse spacing of 5 μs (0.2 mc).

k. Set REPETITION RATE control to 0.5 mc. Adjust R203, 0.5 mc adjust for a pulse spacing of 2 μs (0.5 mc).

l. Set REPETITION RATE control to 1 mc. Adjust R202, 1 mc adjust for a pulse spacing of 1 μs (1 mc).

4.3.3 Pulse Delay Calibration

a. Pulse spacing $\left[\frac{1}{\text{Repetition Rate}}\right]$ should be at least 10 times pulse delay at all times.

b. Set REPETITION RATE switch to 200 cps. VERNIER fully ccw. Set PULSE DELAY switch to 0.5 ms; VERNIER fully cw. Set PULSE WIDTH to 0.5 microsec; VERNIER fully cw. Set POLARITY to "+" ATTENUATOR fully cw. View output pulse terminated into 50 ohm.

c. Set R301 (delay adj) for pulse delay of 0.5 ms.

d. Check ranges from 20 microsec to 10 ms and insure that they are within ± 10%. (It may be necessary to change the setting of R301 somewhat.)

e. Set PULSE DELAY switch to 5 microsec.

f. Set C302 for 5 microsec pulse delay.

g. Check 10 microsec and 2 microsec ranges and insure that they are within ± 10%.

h. Set PULSE DELAY switch to 0.5 microsec.

i. Set C306 for 0.5 microsec pulse delay.

j. Check 1 microsec range and insure that it is within ± 10%.

4.3.4 Pulse Width Calibration

a. Pulse spacing $\left[\frac{1}{\text{Repetition Rate}}\right]$ should be at least 10 times pulse width.

b. Set REPETITION RATE switch to 200 cps, VERNIER ccw.
Set PULSE DELAY switch to 0.5 microsec, VERNIER fully cw.
Set PULSE WIDTH switch to 0.5 ms, VERNIER fully cw.
Set POLARITY to "+", ATTENUATOR fully cw.
View output pulse terminated into 50 ohm.

c. Set R401 (width adj) for a pulse width of 0.5 ms.

d. Check ranges from 20 microsec to 10 ms and insure that they are within ± 10%. (It may be necessary to change the setting of R401 slightly.)

e. Set PULSE WIDTH switch to 5 microsec.

f. Set C402 for a pulse width of 5 microsec.

g. Check 10 microsec and 2 microsec ranges and insure that they are within ± 10%.

h. Set PULSE WIDTH switch to 0.5 microsec.

i. Set C406 for a pulse width of 0.5 microsec.

j. Check 1 microsec range and insure that it is within ± 10%.

4.3.5 Output Waveform

Because the rise of the output waveform is faster than the rated response of most general purpose (30 mc) oscilloscopes, exact observation and rise time measurements may not be made without resorting to either a sampling oscilloscope or traveling wave oscilloscope. Viewing directly on the deflection plates of a slower scope may be used, but it must be kept in mind that there is generally considerable inductance in the deflection plate adapter and the slower sweep speed (20 ns/cm) makes resolution difficult. A general purpose oscilloscope is sufficient for "rough" trimming of output waveform and making top slope adjustment for wide pulses.

a. Set REPETITION RATE control to EXT, VERNIER fully ccw.
Set PULSE DELAY to 0.5 microsec, VERNIER fully cw.
Set PULSE WIDTH to 1 ms, VERNIER fully cw.
Set POLARITY to "+", attenuators for 0 db.
Terminate output pulse into 50-ohm load.
Observe output on 0.5v/cm vertical scale.

b. Set (R90) (Pos Bias) for a base line $\leq$ 0.5v above ground.

c. Set POLARITY control to "-", adjust R88 (Neg Bias) for a base line $\leq$ 5 mv below ground.

d. Set POLARITY control to "+".
Set REPETITION RATE to 0.1 kc.
Set RISE TIME fully ccw.
Adjust R60 (top slope) for min. top slope.
Adjust C39 (roll) for min. top slope following leading edge approximately 5 microsec.

e. Set pulse width to 1 microsec.
Set REPETITION RATE to 10 kc.
Adjust C34 (overshoot) for squarest leading edge with minimum overshoot.

f. Repeat steps 4 and 5 until further adjustment is unnecessary.

g. Fine adjustment of C34 (overshoot) and R88, R90 (output bias) may be made on fast response oscilloscope. Rise time control may be turned slightly cw to help trim any ringing on leading edge. At this point check that both rise and decay times are $\leq$ 10 ns.

h. Because of the wide variation of all controls some combinations of settings may be found that will cause slight oscillations on the flat top. Slight alteration of any control will usually eliminate this condition.

4.3.6 Duty Cycle Overload

WARNING

THIS ADJUSTMENT IS MADE AND SEALED AT THE FACTORY. ANY ALTERATION OF THIS ADJUSTMENT WILL RESULT IN THE LOSS OF WARRANTY AND MAY RESULT IN SERIOUS DAMAGE TO THE INSTRUMENT.

a. Remove V27. With an adapter such as Vector T80C, reinsert V27 with an ammeter in the plate circuit. (Note: the two halves of V27 are paralleled. Care must be taken that both halves are connected through the ammeter.) Connect a dc voltmeter from the +225v test point (TP10) to ground.

b. Set pulse REPETITION RATE control to 10 kc, VERNIER mid scale.
Set PULSE DELAY to 0.5 microsec.
Set PULSE WIDTH to 20 microsec, VERNIER fully ccw.
Set POLARITY to "+", ATTENUATION to 0 db.
Terminate output pulse into 50 ohm.
Energize instrument.

c. Slowly turn PULSE WIDTH VERNIER cw until an ammeter reading of 225 ma is attained.

Adjust R135 (overload adjust) until +225v supply just begins to drop.

d. Turn PULSE WIDTH VERNIER fully cw and insure that ammeter reading does not exceed 240 ma.

e. Turn PULSE WIDTH VERNIER ccw until ammeter reads 220 ma. Note that +225v supply has returned to +225v. Adjust R136 (overload indicator) until average pulse current overload lamp on front panel lights.

f. Turn PULSE WIDTH VERNIER fully ccw. Note that average pulse current overload lamp extinguishes.

g. Turn PULSE WIDTH VERNIER slowly cw. Note that average pulse current overload lamp lights at 220 ma and +225v supply drops at 225 ma. Also note that 240 ma is not exceeded as pulse width vernier is turned fully cw. If these conditions are not met, repeat steps 3 to 7.

4.4 SPECIFICATIONS VERIFICATION

A 1/2 hour warm-up period is required before tests are made. Assemble the following or equivalent equipment:

a. 30-mc oscilloscope (TEKTRONIX 543 and sampling pre-amplifier).

b. Two each dc voltmeter (SIMPSON 260).

c. Tube socket adapter (VECTOR T80C).

d. 50-ohm termination (DATAPULSE Model 1002).

e. 500 kc Signal Generator (HEWLETT-PACKARD).

4.4.1 Power Supply (Repetition Rate Switch on EXT)

4.4.1.1 -105v Supply

Verify that the voltage from TP8 to ground is -105v ± 10%.

4.4.1.2 +110v Supply

Verify that the voltage from TP9 to ground is +110v ±10%.

4.4.1.3 +225v Supply

Verify that the voltage from TP10 to ground is +225v ± 10%.

4.4.1.4 +150v (Variable Reference) Supply

With polarity switch in "+" position, verify that the voltage from TP11 to ground is +150v ± 10%.

4.4.1.5 Bias Supply

Verify that the voltage from junction of C54 and R110 to ground is -18v, +30%-0%.

Verify that the voltage from junction of R110 & R111 to ground is between -5.1 and -6.2.

4.4.2 Repetition Rate

Set PULSE DELAY to 0.5 microsec, VERNIER fully cw.
Set PULSE WIDTH to 0.5 microsec, VERNIER fully ccw.
Set POLARITY to "+", RISE TIME fully ccw.
Set ATTENUATORS fully cw, terminate pulse output into 50 ohm.
Sync scope from positive sync pulse output. View pulse output at SWEEP SPEED of 0.1 microsec/cm and with vertical sensitivity of 20v/cm.
See Repetition Rate Settings (Table 4-1).

TABLE 4-1

REPETITION RATE CALIBRATION CHECK

REPETITION RATE		WIDTH	SCOPE SWEEP SPEED	CORRECT SPACINGS	TOLERANCE
SWITCH	VERNIER				
2 mc	cw	Min.	0.1 μs/cm	0.33 μs (3 mc)	+0, -10%
2 mc	ccw	Min.	0.1 μs/cm	0.5 μs (2 mc)	±10%
1 mc	ccw	Min.	0.2 μs/cm	1 μs (1 mc)	±10%
0.5 mc	ccw	Min.	0.5 μs/cm	2 μs (0.5 mc)	±10%
0.2 mc	ccw	Min.	1 μs/cm	5 μs (0.2 mc)	±10%
0.1 mc	ccw	Min.	2 μs/cm	10 μs (0.1 mc)	±10%
50 kc	ccw	Min.	5 μs/cm	20 μs (50 kc)	±10%
20 kc	ccw	1 μs	10 μs/cm	50 μs (20 kc)	±10%
10 kc	ccw	1 μs	20 μs/cm	100 μs (10 kc)	±10%
5 kc	ccw	1 μs	50 μs/cm	200 μs (5 kc)	±10%
2 kc	ccw	1 μs	0.1 ms/cm	0.5 ms (2 kc)	±10%
1 kc	ccw	10 μs	0.2 ms/cm	1 ms (1 kc)	±10%

TABLE 4-1

REPETITION RATE CALIBRATION CHECK (Cont.)

REPETITION RATE		WIDTH	SCOPE SWEEP SPEED	CORRECT SPACINGS	TOLERANCE
SWITCH	VERNIER				
0.5 kc	ccw	10 μs	0.5 ms/cm	2 ms (0.5 kc)	±10%
0.2 kc	ccw	10 μs	1 ms/cm	5 ms (0.2 kc)	±10%
0.1 kc	ccw	0.1 ms	2 ms/cm	10 ms (0.1 kc)	±10%
50 cps	ccw	0.1 ms	5 ms/cm	20 ms (50 cps)	±10%
20 cps	ccw	0.1 ms	10 ms/cm	50 ms (20 cps)	±10%
10 cps	ccw	1 ms	20 ms/cm	100 ms (10 cps)	±10%
10 cps	cw	1 ms	5 ms/cm	Less than 47 ms	---
5 cps	cw	1 ms	10 ms/cm	Less than 95 ms	---
5 cps	ccw	1 ms	50 ms/cm	200 ms (5 cps)	±10%
2 cps	ccw	1 ms	0.1 sec/cm	0.5 sec (2 cps)	±10%
2 cps	cw	1 ms	20 ms/cm	Less than 190 ms	---

4.4.2 (cont.)

Set PULSE WIDTH to 0.5 microsec.
Set PULSE DELAY to 0.5 microsec.
Set REPETITION RATE and VERNIER fully cw.
Set SWEEP SPEED to 10 microsec/cm.
Expand sweep x 100.
View leading edge of 10th pulse and verify that jitter is less than 0.8 cm (0.8%).
Set REPETITION RATE switch to EXT, VERNIER fully ccw.
Set PULSE WIDTH to 0.5 microsec, VERNIER fully ccw.
Apply 20v rms sine wave at 500 kc to positive external trigger input jack.
Set SWEEP SPEED at 1 microsec/cm.
Verify triggering stability.
Remove sine wave input and apply 20v positive pulse (.1 microsec rise) 3 mc sweep speed .1 microsec/cm.
Verify triggering stability.
Remove pulse input.
Set PULSE WIDTH to 10 ms, VERNIER fully cw.
SWEEP SPEED 2 mc/cm.
Depress single pulse push button.
Verify occurrence of single pulse.
Set PULSE WIDTH to 0.5 microsec, VERNIER ccw.
Set PULSE DELAY to 0.5 microsec, VERNIER ccw.
Set PULSE REPETITION RATE to 2 mc, VERNIER cw.
Set SWEEP SPEED to 0.1 microsec/cm.
View sync pulse; verify amplitude is greater than 20v.
Terminate sync into 100 ohm.
Verify that amplitude is greater than 10v.

4.4.3 Pulse Delay

Set PULSE WIDTH control to 1 microsec, VERNIER fully cw (Min.)
Set POLARITY to "+", RISE TIME fully cw.
Set ATTENUATOR controls fully cw.
Terminate output pulse into 50 ohm.
Sync scope from positive sync output.
View output pulse and sync pulse simultaneously (dual trace).
SWEEP SPEED 0.1 microsec/cm, VERTICAL SENSITIVITY 20v/cm.
Note that delay is measured from the 50% point on leading edge of the sync pulse to the 50% point on the leading edge of the output pulse.
See Pulse Delay Settings. (Table 4-2)

TABLE 4-2
PULSE DELAY CALIBRATION CHECK

REPETITION RATE	WIDTH	DELAY		SCOPE SWEEP SPEED	CORRECT DELAY ±5%
		SWITCH	VERNIER		
1 kc	1 μs	0.5 μs	ccw	0.1 μs/cm	Approx. 0.2 μs
1 kc	1 μs	0.5 μs	cw	0.1 μs/cm	0.5 μs
1 kc	1 μs	1 μs	cw	0.2 μs/cm	1 μs
1 kc	1 μs	2 μs	cw	0.5 μs/cm	2 μs
1 kc	1 μs	5 μs	cw	1 μs/cm	5 μs
1 kc	1 μs	10 μs	cw	2 μs/cm	10 μs
1 kc	1 μs	20 μs	cw	5 μs/cm	20 μs
1 kc	1 μs	50 μs	cw	10 μs/cm	50 μs
1 kc	1 μs	0.1 ms	cw	20 μs/cm	0.1 ms
0.1 kc	1 μs	0.2 ms	cw	50 μs/cm	0.2 ms
0.1 kc	1 μs	0.5 ms	cw	0.1 ms/cm	0.5 ms
0.1 kc	1 μs	1 ms	cw	0.2 ms/cm	1 ms
10 cps	0.1 ms	2 ms	cw	0.5 ms/cm	2 ms
10 cps	0.1 ms	2 ms	ccw	0.1 ms/cm	Less than 0.95 ms
10 cps	0.1 ms	5 ms	ccw	0.2 ms/cm	Less than 1.9 ms
10 cps	0.1 ms	5 ms	cw	1 ms/cm	5 ms
10 cps	0.1 ms	10 ms	cw	2 ms/cm	10 ms
10 cps	0.1 ms	10 ms	ccw	0.5 ms/cm	Less than 4.7 ms

Set PULSE REPETITION RATE to 0.1 kc, SWEEP SPEED 2 ms/cm.
Slowly turn PULSE DELAY VERNIER cw and verify that 70% duty cycle can be exceeded without circuit failure.
Set PULSE DELAY to 1 ms, VERNIER fully cw.
Set SWEEP SPEED at 0.2 ms/cm.
Expand sweep x 100 and view leading edge of pulse.
Verify that jitter is less than 1/2 cm (0.05%).

4.4.4 Pulse Width

Set PULSE DELAY control to 0.5 microsec, VERNIER fully ccw.
Set POLARITY control to "+", RISE TIME fully ccw.
Set ATTENUATOR controls fully cw.
Terminate output pulse into 50 ohm.
Sync scope from positive sync output.
View output pulse.
SWEEP SPEED 0.1 microsec/cm, VERTICAL SENSITIVITY 20v/cm.
Note that width is measured from the 50% point on the leading edge of the output pulse to the 50% point on the lagging edge of the output pulse.
See Pulse Width Settings. (Table 4-3)

TABLE 4-3
PULSE WIDTH CALIBRATION CHECK

REPETITION RATE	PULSE WIDTH		SCOPE SWEEP SPEED	CORRECT PULSE WIDTH ±10%
	SWITCH	VERNIER		
1 kc	0.5 μs	ccw	0.1 μs/cm	Approx. 0.5 μs
1 kc	0.5 μs	cw	0.1 μs/cm	0.5 μs
1 kc	1 μs	cw	0.2 μs/cm	1 μs
1 kc	2 μs	cw	0.5 μs/cm	2 μs
1 kc	5 μs	cw	1 μs/cm	5 μs
1 kc	10 μs	cw	2 μs/cm	10 μs
1 kc	20 μs	cw	5 μs/cm	20 μs
1 kc	50 μs	cw	10 μs/cm	50 μs
1 kc	0.1 ms	cw	20 μs/cm	0.1 ms
0.1 kc	0.2 ms	cw	50 μs/cm	0.2 ms
0.1 kc	0.5 ms	cw	0.1 ms/cm	0.5 ms
0.1 kc	1 ms	cw	0.2 ms/cm	1 ms
10 cps	2 ms	cw	0.5 ms/cm	2 ms
10 cps	2 ms	ccw	0.1 ms/cm	Less than 0.95 ms
10 cps	5 ms	ccw	0.2 ms/cm	Less than 1.9 ms
10 cps	5 ms	cw	1 ms/cm	5 ms
10 cps	10 ms	cw	2 ms/cm	10 ms
10 cps	10 ms	ccw	0.5 ms/cm	Less than 4.7 ms

Set PULSE WIDTH switch to 1 ms, VERNIER fully cw.
Set SWEEP SPEED at 0.2 ms/cm.
Expand sweep x 100 and view lagging edge of pulse.
Verify that jitter is less than 1/2 cm (0.05%).

4.4.5 Output Waveform

a. Set PULSE REPETITION RATE switch to 2 mc, VERNIER fully cw.
Set PULSE DELAY to 0.5 microsec, VERNIER fully ccw.
Set PULSE WIDTH to 0.5 microsec, VERNIER fully ccw.
Set POLARITY to "+", RISE TIME fully ccw.
Set ATTENUATOR controls fully cw.
Sync scope from positive sync output.
View output pulse terminated into 50 ohm.
SWEEP SPEED 0.1 microsec/cm; VERTICAL SENSITIVITY 20v/cm.

b. Observe that amplitude is equal to or greater than 50v.

c. Set POLARITY to "-".
Observe that amplitude is equal to or greater than 50v.

d. Set POLARITY to "+".

e. Step ATTENUATOR to 10 db in 2 db steps and observe with full amp. 60v.

2 db amplitude is 48v ±10%.
4 db amplitude is 38v ±10%.
6 db amplitude is 30v ±10%.
8 db amplitude is 24v ±10%.
10 db amplitude is 19v ±10%.

f. Return control fully cw.

g. Step ATTENUATOR to 50 db in 10 db steps. Observe.

10 db amplitude is 19v ±10%.
20 db amplitude is 6v ±10%.
30 db amplitude is 1.9v ±10%.
40 db amplitude is 0.6v ±10%.
50 db amplitude is 0.19v ±10%.

h. Return control fully cw.

i. Set REPETITION RATE control to 10 kc, VERNIER fully ccw.
Set PULSE WIDTH to 1 microsec, VERNIER fully cw.

j. Observe overshoot is less than 4% (it may be necessary to trim overshoot somewhat with rise time control).

k. Set RISE TIME control fully cw.
Observe that RISE TIME is greater than 0.5 microsec.

l. Set REPETITION RATE to 50 cps.
Set PULSE WIDTH to 1 ms, SWEEP SPEED 0.2 ms/cm.

m. Observe TOP SLOPE is less than 3%.

n. Set REPETITION RATE to 10 kc.
Set PULSE WIDTH to 0.5 microsec, VERNIER fully ccw.
Observe output waveform terminated into 50 ohm on sampling oscilloscope.

o. Observe that rise and decay times are equal to or less than 10 nanosec (from 10% to 90% point on leading edge and lagging edge respectively).

p. De-energize equipment. Using a device such as VECTOR T80C, insert an ammeter in plate circuit of V27 taking care that both halves of tube are connected through the ammeter. Connect a voltmeter from TP10 (+225v) to ground.

q. Energize equipment.

r. Set PULSE REPETITION RATE to 0.1 mc, VERNIER centered.
Set PULSE DELAY to 0.5 microsec, VERNIER fully ccw.
Set PULSE WIDTH to 2 microsec, VERNIER fully ccw.

s. Slowly turn PULSE WIDTH VERNIER cw noting ammeter reading.
Verify that average pulse current overload lamp lights at approximately 220 ma.

t. Continue increasing duty cycle and note that +225v supply decreases in voltage at 225 ma.

u. De-energize equipment and remove ammeter and voltmeter.

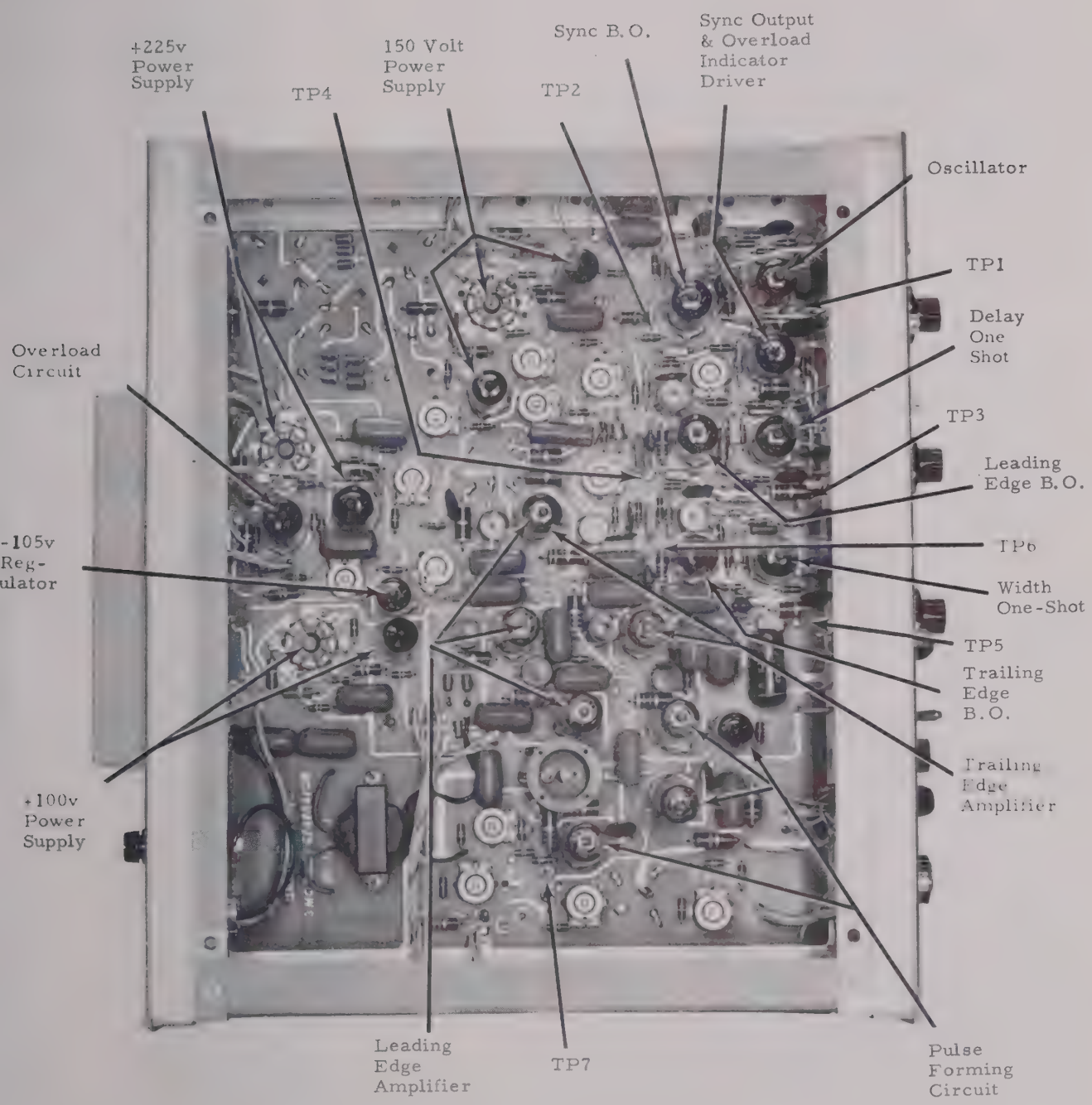
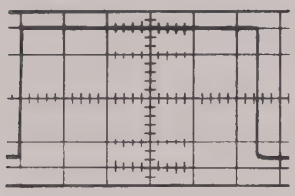


FIGURE 4-2. MODEL 102 TEST POINTS AND CIRCUIT LOCATIONS

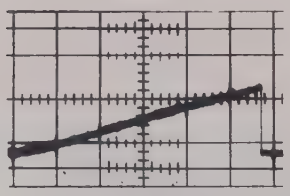
FIGURE 4-1. WAVEFORM SUMMARY

TROUBLE SHOOTING AIDS

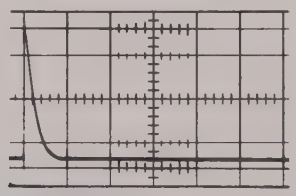
Sweep Speed 0.2 μs/cm---Vertical Sensitivity 20v/cm



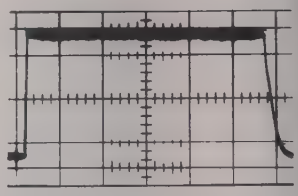
Proper Waveform



Loss of Leading Trigger; Check V8A, V10, V11, or V13



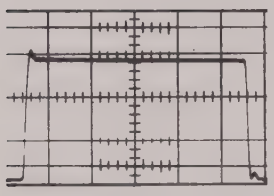
Loss of Duration Gate; Check V6 or V14



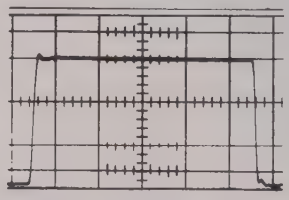
Loss of Trailing Edge Trigger; Check V7, V8B, V9 or V12

CONTROLS FOR WAVEFORM TRIMMING

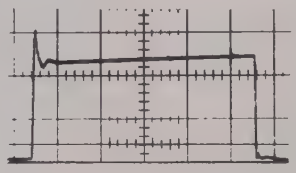
Sweep Speed 0.2 μs/cm---Vertical Sensitivity 20v/cm



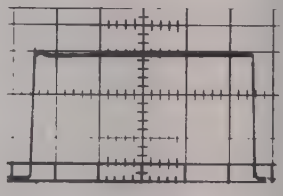
Rise Time not Compensated



Rise Time Control Turned Slightly Cw (Proper Waveform)

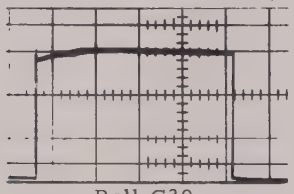


Overshoot C34 Overcompensated

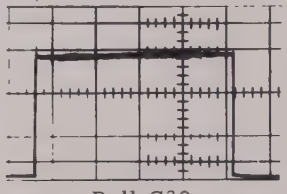


Overshoot C34 Undercompensated

.....Sweep Speed 2 μs/cm.....

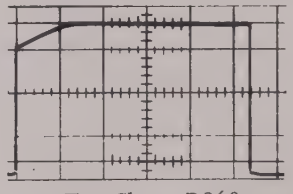


Roll C39 Overcompensated

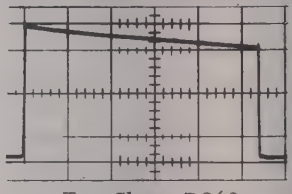


Roll C39 Undercompensated

.....Sweep Speed 20 μs/cm.....



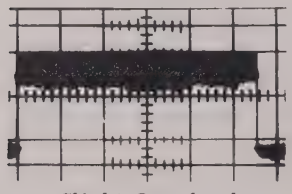
Top Slope R260 Overcompensated



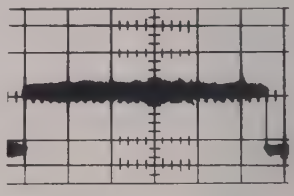
Top Slope R260 Undercompensated

EFFECT OF AVERAGE PULSE CURRENT OVERLOAD CIRCUIT

Sweep Speed 10 μs/cm---Vertical Sensitivity 20v/cm



Slight Overload



Extreme Overload

TABLE 4-4

VOLTAGE AND RESISTANCE

Measurements were taken under the following conditions:

All measurements are with respect to ground.

Resistance measurements with negative meter terminal connected to ground.

All voltages are dc unless noted.

Voltage measurements are at 115v ac line.

Measurements were made with Simpson Model 260 (20, 000 ohms per volt).

Repetition rate control was on EXT.

Pulse Delay control was on 0.5 microsec.

Pulse Width control was on 0.5 microsec.

Both attenuation controls were on "0".

Polarity switch was on "+".

The voltages and resistances tabulated here are typical values. On some instruments the readings will differ considerably from this tabulation due to manufacturing tolerances and variations in component characteristics. These tables should be used in conjunction with careful study of the schematic diagrams and the "Theory of Operation" section of this manual.

	VOLTAGE PIN NUMBER									RESISTANCE PIN NUMBER								
UBE	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
6DJ8	+70	0	+25	0	6.3 ac	+75	+25	+25	---	150k	10k	780 Ω	0	0	100k	1k	780 Ω	---
6DJ8	+100	-5.6	0	0	6.3 ac	+100	-5.6	0	---	100k	5k	0	0	0	100k	400 Ω	470 Ω	---
6DJ8	+10	0	0	6.3 ac	0	+100	0	+3	---	130k	200k	0	0	0	100k	470 Ω	470 Ω	---
6DJ8	+2	0	0	6.3 ac	0	+100	-4	0	---	200k	∞	50Ω	0	0	100k	150 K	50Ω	---
6DJ8	+100	-5.6	0	0	6.3 ac	+100	-5.6	0	---	100k	3k	0	0	0	100k	500 Ω	3Ω	---
6DJ8	+2	0	0	6.3 ac	0	+100	-4	0	---	200k	∞	50Ω	0	0	100k	150 K	50Ω	---
6DJ8	+100	-5.6	0	6.3 ac	0	+100	-5.6	0	---	100k	3k	0	0	0	100k	1k	3Ω	---
6DJ8	+100	-5.6	0	0	6.3 ac	+100	-5.6	0	0	100k	1.5k	0	0	0	100k	1k	0	0
7119	+225	-18	0	6.3 ac	6.3 ac	0	-18	0	+225	300k	100Ω	0	0	0	0	10Ω	0	300k
0: 7119	+225	-18	0	6.3 ac	6.3 ac	0	-18	0	+225	300k	10Ω	0	0	0	0	10Ω	0	300k
1: 7119	+225	-18	0	6.3 ac	6.3 ac	0	-18	0	+225	300k	10Ω	0	0	0	0	10Ω	0	300k
2: 7119	+2	-18	0	6.3 ac	6.3 ac	0	-18	0	+12	300k	10Ω	0	0	0	0	10Ω	0	10k
3: 7119	0	0	+2	6.3 ac	6.3 ac	+2	0	0	0	0	0	300k	0	0	300k	0	0	0
4: 6AU6	0	0	6.3 ac	0	+2	+100	0			∞	0	0	0	300k	100k	0		
5: 7119	+225	+2	+12	6.3 ac	6.3 ac	+12	+2	0	+225	300k	300k	10k	0	0	10k	300 K	0	300k
6:12BH7	0	-40	-40	3.15 ac	3.15 ac	+150	+150	+150	3.15 ac	0	300k	150k	0	0	500k	500 k	∞	0
7: 6DQ5	-40	3.15 ac	0	+150	-40	0	3.15 ac	+150	+150*	150k	0	50Ω	∞	150k	50Ω	0	∞	500k
8: 6DQ5	-40	3.15 ac	0	+150	-40	0	3.15 ac	+150	+150*	150k	0	50Ω	∞	150k	50Ω	0	∞	500k
9: QB2	0	-105	0	-105	0	0	-105			0	3.5k	∞	3.5 k	0	∞	3.5 k		
0:6AU6	-30	0	6.3 ac	0	+75	+85				200k	0	0	0	1.5m	100k	0		
1:6AS7	+75	+200	+100	+75	+200	+100	0	6.3 ac		1.5m	100k	100k	1.5 m	100k	100k	0	0	
2:6U8A	+45	-10	+100	6.3 ac	0	+150	0	0	0	100k	400k	100k	0	0	1.5m	0	0	400k
3:6AS7	+130	+320	+225	+130	+320	+225	6.3 ac	0	---	1.5m	200k	300k	1.5 m	200k	300k	0	0	---

*Plate Cap

Continued------

TABLE 4-4 (Continued)
VOLTAGE AND RESISTANCE

	VOLTAGE PIN NUMBER									RESISTANCE PIN NUMBER								
TUBE	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
V24:6U8A	+100	-10	+130	6.3 ac	0	+130	0	0	-4	100k	200k	100k	0	0	1.5m	0	0	250k
V25: OB2	0	-105	0	-105	0	0	-105			0	20k	∞	20k	0	∞	20k		
V26:6AU6	-4	0	6.3 ac	0	+65	+125	0			100k	0	0	0	1.5 m	80k	0		
V27:6AS7	+65	+250	+150	+65	+250	+150	0	6.3 ac		1.5 m	100k	500k	1.5 m	100k	500k	0	0	

SECTION V

PARTS LIST

5.1 HOW TO USE THIS PARTS LIST.

5.1.1 Reference Designations

Reference designations used throughout this listing correspond with reference designations given on component location photos and the following schematics:

Drawing No. 37000-005
Drawing No. 40000-001
Drawing No. 37000-006
Drawing No. 40000-002
Drawing No. 37000-007
Drawing No. 40000-003
Drawing No. 37000-000
Drawing No. 37000-001
Drawing No. 40000-004
Drawing No. 40000-000

Resistors are designated as R1, R2, R3, etc. and are fixed value, composition, 10% and 1/2 w unless otherwise noted.

Capacitors are designated as C1, C2, C3, etc. and are fixed value, 10%, 500v dc unless otherwise noted.

Diodes are designated as CR1, CR2, CR3; switches as S1, S2, S3; and inductors as L1, L2, and L3, etc.

5.1.2 Abbreviations

The following abbreviations are used:

CER	- Ceramic
DPC	- Deposited Carbon
ELECT	- Electrolytic
M	- Mica
MP	- Metalized Paper
GMV	- Guaranteed Min. Value
OF	- Oil Filled
PT	- Paper Tubular
SM	- Silver Mica
VAR	- Var.
WW	- Wire Wound
VTQ	- Vitamin Q
PNP	- Positive-Negative-Positive
NPN	- Negative-Positive-Negative
μsec	- Microsecond
μF	- Microfarad
μh	- Microhenry
ns	- Nanosecond
ms	- Millisecond

5.2 RESISTORS

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S PART NO.
R1	20	47 Ω	10021-470	(AB)* EB4701
R2	4	10 k	10021-103	(AB) EB1031
R3		Same as R2		
R4		Same as R1		
R5	2	100 Ω, 5%	10011-101	(AB) EB1015
R6	1	15 k, 1 w	10022-153	(AB) GB1531
R7	1	22 k	10021-223	(AB) EB2231
R8	7	1 k, 2 w	10023-102	(AB) HB1021
R9	4	1 k	10021-102	(AB) EB1021
R10	1	180 k	10021-184	(AB) EB1841
R11	2	3.3 k	10021-332	(AB) EB3321
R12		Same as R1		
R13	4	470 Ω, 1 w	10022-471	(AB) GB4711
R14	2	220 Ω	10021-221	(AB) EB2211
R15		Same as R9		
R16		Same as R13		
R17		Same as R1		
R18		Same as R1		
R19	16	100 k	10021-104	(AB) EB1041
R20	2	27 k	10021-273	(AB) EB2731
R21	6	47 Ω, 5%	10011-470	(AB) EB4705
R22		Same as R19		
R23		Same as R20		
R24		Same as R21		
R25		Same as R2		
R26		Same as R2		
R27	9	470 Ω, 2 w	10023-471	(AB) HB4711
R28	2	270 k	10021-274	(AB) EB2741
R29		Same as R27		
R30		Same as R28		
R31	2	2.2 k	10021-222	(AB) EB2221

*(AB)-Allen Bradley

5.2 RESISTORS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S PART NO.
R32		Same as R9		
R33		Same as R31		
R34		Same as R1		
R35		Same as R13		
R36		Same as R1		
R37		Same as R13		
R38		Same as R14		
R39		Same as R9		
R40		Same as R27		
R41		Same as R11		
R42		Same as R1		
R43		Same as R1		
R44		Same as R27		
R45		Same as R27		
R46		Same as R1		
R47		Same as R1		
R48		Same as R27		
R49		Same as R27		
R50		Same as R1		
R51		Same as R1		
R52		Same as R27		
R53		Same as R27		
R54		22 Ω	10021-220	(AB) EB2201
R55		680 Ω, 2 w	10023-681	(AB) HB6811
R56		Same as R55		
R57		3.3 m	10021-335	(AB) EB3351
R58		Same as R54		
R59		220 k	10021-224	(AB) EB2241
R60		Var., 250 k, 2 w, 30%	20240-254	(CTS)* 33351
R61		Same as R19		
R62		150 k	10021-154	(AB) EB1541
R63	9	10 k, 2 w	10023-103	(AB) HB1031
R64	1	Var., 5 k, 2 w	20053-502	(AB) Jain0565502UA
R65		Same as R54		
R66	1	4.7 k	10021-472	(AB) EB4721
R67		Same as R19		
R68	1	330 Ω, 2 w	10023-331	(AB) HB3311
R69	6	10 Ω	10021-100	(AB) EB1001
R70	8	2.7 Ω, 1 w	10022-279	(AB) GB27G1
R71	8	10 Ω, 2 w	10023-100	(AB) EB6805
R72		Same as R69		
R73		Same as R70		
R74		Same as R69		
R75		Same as R70		
R76		Same as R71		
R77		Same as R69		
R78		Same as R70		
R79		Not Used		
R80	7	150 Ω, 2 w	10023-151	(AB) HB1511
R81		Same as R80		
R82		Same as R80		
R83		Same as R80		
R84		Same as R80		
R85		Same as R80		
R86		Same as R19		
R87		Same as R19		
R88		Same as R60		
R89		Same as R19		
R90		Same as R60		
R91		Same as R19		
R92	3	100 k, 1 w	10022-104	(AB) GB1041
R93		Same as R19		
R94	3	1 m	10021-105	(AB) EB1051

2 RESISTORS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR,) & MFR'S PART NO.
R95		Same as R1		
R96		Same as R1		
R97		22 Ω, 1 w	10022-220	(AB) GB2201
R98		Same as R97		
R99		Same as R19		
R100		Same as R60		
R101		68 k	10021-683	(AB) EB6831
R102		2.7 Ω	10022-279	(AB) GB27G1
R103		Same as R97		
R104	3	3.3 k, 2 w	10023-332	(AB) HB3321
R105		Same as R104		
R106		Same as R104		
R107		Same as R97		
R108		Same as R8		
R109		Same as R8		
R110		Same as R80		
R111	2	470 Ω	10021-471	(AB) EB4711
R112		Same as R92		
R113		Same as R19		
R114		Same as R92		
R115		Same as R19		
R116		Same as R94		
R117		Same as R94		
R118		Same as R1		
R119		Same as R1		
R120		Same as R1		
R121		Same as R1		
R122		Same as R97		
R123		Same as R97		
R124		Same as R97		
R125		Same as R97		
R126	3	470 k	10021-474	(AB) EB4741
R127		Same as R60		
R128		Same as R19		
R129		Same as R19		
R130		Same as R60		
R131		Same as R19		
R132		Same as R59		
R133	1	1.5 m	10021-155	(AB) EB1551
R134				
R135		Same as R60		
R136		Same as R60		
R137		Same as R59		
R138	1	33 k	10021-333	(AB) EB3331
R139	2	10 k, 1 w	10022-103	(AB) GB1031
R140		Same as 126		
R141	2	680 k	10021-684	(AB) EB6841
R142		Same as R139		
R143		Same as R126		
R144		Same as R141		
R145		Same as R1		
R146		Not Used		
R147	1	100 Ω	10021-101	(AB) EB1011
R148		Through 200 - not used		

5.2 RESISTORS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S. PART NO.
R201	4	Var., W.W., 500 Ω, 2 w, 20%	10603-501	(CTS) Series 112
R202		Same as R201		
R203		Same as R201		
R204	1	3.3 k, 5%	10011-332	(AB) EB3325
R205	1	150 k, 5%	10011-154	(AB) EB1545
R206	1	270 Ω, 5%	10011-274	(AB) EB2745
R207A, B	2	Var., 500 Ω x 2 m dual 20%, 2 w	20213-205	
R208	1	200 k, 5%	10011-204	(AB) EB2045
R209	2	510 k, 5%	10011-514	(AB) EB5145
R210	1	680 k, 5%	10011-684	(AB) EB6845
R211		Same as R60		
R212	1	470 k, 5%	10011-474	(AB) EB4745
R213		Same as R209		
R214		Same as R201		
R215		Same as R111		
R216	1	330 Ω, 2 w, 5%	10013-331	(AB) HB3305
R217	8	36 Ω, 5%	10011-360	(AB) EB3605
R218		Same as R5		
R219	1	270 Ω, 5%	10011-271	(AB) EB2715
R220	1	47 K, 5%	10011-473	(AB) EB4735
R221	3	Var., 500 k, 2 w, 30%	20240-104	(CTS) 33803
R222	1	1 m, 0.2 w, 30%	20240-105	(CTS) 33803
R223		Not Used		
R301		Same as R221		
R302		Same as R57		
R303A, B		Same as R207A, B		
R304	2	330 k, 5%	10011-334	(AB) EB3345
R305	3	68 Ω, 5%	10011-680	(AB) EB6805
R306	4	150 Ω, 5%	10011-151	(AB) EB1515
R307		Same as R306		
R308		Same as R305		
R309		Same as R69		
R310		Not Used		
R401		Same as R221		
R402		Same as R57		
R403A, B		Same as R207A, B		
R404		Same as R304		
R405		Not Used		
R406		Same as R306		
R407		Same as R306		
R408		Same as R21		
R409		Same as R69		

5.2 RESISTORS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S. PART NO.
R501	1	Var., 50 Ω, 2 w	20053-500	(AB) Jain0565500UA
R502	1	47 Ω, 2 w	10023-470	(AB) HB4701
R503		Same as R71		
R504		Same as R71		
R505		Same as R71		
R506		Same as R71		
R507		Same as R63		
R508		Same as R63		
R509		Same as R63		
R510		Same as R63		
R511		Same as R63		
R512		Same as R63		
R513		Same as R63		
R514		Same as R63		
R515		Same as R71		
R516	2	15 Ω, 1 w	10022-150	(AB) GB1501
R517		Same as R516		
R518		Same as R71		
R519		Same as R8		
R520		Same as R8		
R521		Same as R8		
R522		Same as R8		
R523	1	1.5 k, 2 w	10023-152	(AB) HB1521
R524	8	5.6 Ω, 1 w	10022-569	(AB) GB56G1
R525		Same as R524		
R526	4	820 Ω, 2 w	10023-821	(AB) HB8211
R527		Same as R526		
R528		Same as R526		
R529		Same as R526		
R530		Same as R524		
R531		Same as R524		
R532		Same as R55		
R533		Same as R55		
R534		Same as R55		
R535		Same as R524		
R536		Same as R524		
R537		Same as R55		
R538		Same as R55		
R539		Same as R55		
R540		Same as R524		
R541		Same as R524		
R542		Same as R55		
R543		Same as R55		
R544		Same as R55		
R545	11	36 Ω, 2 w, 5%	10013-360	(AB) HB3601
R546		Same as R545		
R547		Same as R545		
R548		Same as R545		
R549		Same as R545		
R550		Same as R545		
R551		Same as R545		
R552		Same as R545		
R553		Same as R545		
R554		Same as R545		
R555	8	390 Ω, 2 w, 5%	10013-391	(AB) HB3915
R556		Same as R555		
R557		Same as R555		
R558		Same as R555		
R559		Same as R555		
R560		Same as R555		
R561		Same as R555		
R562		Same as R555		
R563		Same as R545		

5.2 RESISTORS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S. PART NO.
R564		Same as R217		
R565	1	47 Ω, 2 w, 5%	10013-470	(AB) HB4705
R566		Same as R217		
R567		Same as R217		
R568		Same as R21		
R569		Same as R217		
R570		Same as R217		
R571		Same as R21		
R572		Same as R217		
R573		Same as R217		
R574		Same as R21		
R575		Same as R70		
R576		Same as R70		
R577		Same as R70		

5.3 CAPACITORS

C1	22	.01 μF, $^{+80\%}_{-20}$, Cer. Disc	11247-103	(Er) 841-01
C2	23	.1 μF, 400v, Paper Mylar	11066-103	(Ar) 4DP-3-104
C3	2	27 μμF, 5%, SM	11017-270	(Sa) RR1427
C4		Same as C1		
C5	2	100 μμF, 5%, SM	11017-101	---- RR1310
C6		Same as C1		
C7		Same as C2		
C8		470 μμF, 300v, 5%, SM	11015-471	(Sa) RR06347
C9	4	47 μμF, 5%, SM	11017-470	(Sa) RR1447
C10		Same as C9		
C11	2	15 μμF, 5%, SM	11017-150	(Sa) RR1415
C12		Same as C11		
C13		Same as C1		
C14		Same as C2		
C15		Same as C2		
C16		Same as C9		
C17		Same as C9		
C18		Same as C8		
C19		Same as C1		
C20		Same as C1		
C21	1	1000 μμF, 5%, SM	11037-102	(Sa) KR1210
C22		Same as C1		
C23		Same as C8		
C24		Same as C1		
C25		Same as C1		
C26		Same as C2		
C27		Same as C2		
C28		Same as C2		
C29		Same as C2		
C30		Same as C2		
C31		Same as C2		
C32		Same as C2		
C33		Same as C2		
C34	1	1.5 to 7 μμF, Var. Cer.	11307-709	(Er) TS-A
C35	1	5 μF, 200v, Paper Mylar	11064-504	(Ar) 2DP-5-504
C36		Same as C2		
C37		Same as C2		
C38		Same as C2		
C39	1	4 to 30 μμF, Var. Cer.	11307-300	(Er) TS-2A
C40	2	20 μF, 250v	11154-206	(CD) BR-20-250
C41		Same as C1		
C42	7	150 μF, 350v, Elect, P.C. Mntg.	11165-157	(Sa) PLP-150-350V
C43		Same as C2		
C44		Same as C1		
C45		Same as C42		
C46		Not Used		

*=(Er)-Erie

5.3 CAPACITORS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S PART NO.
C47	1	220 μμF, 5%, SM	11017-221	(Sa)* RR1322
C48		Same as C2		
C49		Same as C42		
C50		Same as C42		
C51		Same as C42		
C52		Same as C42		
C53		Same as C42		
C54	1	1500 μF, 50v, ELECT, PC Mntg.	11162-158	(Sa) PLP1500-50
C55		Not Used		
C56		Same as C1		
C57		Same as C1		
C58		Same as C1		
C59		Same as C1		
C60		Same as C1		
C61		Same as C1		
C62		Same as C1		
C63		Same as C1		
C64		Same as C1		
C65		Same as C1		
C66		Same as C2		
C67		Same as C2		
C68		Same as C2		
C69		Same as C40		
C70		Same as C2		
C71		Same as C2		
C72		Same as C2		
C73		Not Used		
C74		Not Used		
C75		Not Used		
C76		Not Used		
C77		Same as C3		
C78 through 200		Not used		
C201	3	.1 μF, 200v, 1%, VTQ	11093-104	(Ec)* 250
C202	1	1.0 μF, 100v, 1%, VTQ	11093-105	(Ec) 250
C203	6	2.7 to 30 PF. 175v, VAR, M	11025-103	(Ar)* 461
C204	3	.01 μF, 300v, 1%, SM	11025-103	(Sa) CR1110F
C205	3	1000 μμF, 1%, SM	11027-102	(Sa) CR1210
C206		Same as C203		
C207	1	68 μμF, 5%, SM	11017-680	(Sa) RR1468
C208 through 300		Not Used		

*=(Sa)-Sangamo - (Ec)-Electrocube - (Ar)-Arco

5.3 CAPACITORS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S PART NO.
C301	2	82 μμF, 5%, SM	11017-820	(Sa) RR1482
C302		Same as C203		
C303		Same as C205		
C304		Same as C204		
C305		Same as C201		
C306		Same as C203		
C307 through C400		Not Used		
C401		Same as C301		
C402		Same as C203		
C403		Same as C205		
C404		Same as C204		
C405		Same as C201		
C406		Same as C203		
C407 through C500		Not Used		
C501		Same as C5		

5.4 TUBES (Vacuum Type Unless Otherwise Noted)

V1	8	6 DJ8, 8-Pin, 6.3v Fil., .365a	12012-000	(Am)* 6DJ8
V2		Same as V1		
V3		Same as V1		
V4		Same as V1		
V5		Same as V1		
V6		Same as V1		
V7		Same as V1		
V8		Same as V1		
V9	6	7119, 9-Pin, 6.3/12.6v Fil	12032-001	(Am) 7119
V10		Same as V9		
V11		Same as V9		
V12		Same as V9		
V13		Same as V9		
V14	3	6AU6A, 7-Pin, 6.3/12.6v Fil.	12030-000	(RCA) 6AU6A
V15		Same as V9		
V16	1	12BH7A, 9-Pin, 6.3/12.6v Fil.	12032-000	(RCA) 12BH7A
V17	2	6DQ5, 8-Pin, 6.3v Fil, 2.5a	12011-000	(RCA) 6DG5
V18		Same as V17		
V19	2	OB2, GAS, 7-Pin, Ref. Type	12060-000	(TS)* OB2
V20		Same as V14		
V21	3	6AS7GA, 8-Pin, 6.3v Fil., 2.5a	12011-001	(RCA) 6AS7GA
V22	2	6U8A, 9-Pin, 6.3v Fil., .45a	12012-001	(RCA) 6AU8A
V23		Same as V21		
V24		Same as V22		
V25		Same as V19		
V26		Same as V14		
V27		Same as V21		

*=(Am)-Ampex - (TS)-Tung-sol

5.5 MISCELLANEOUS

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR.'S PART NO.
DL1	1	Delay Line, .09 μs, 500 Ω, wire leads	14200-001	(MC)* DDL500-.09
CR1	7	Diode, Silicon, C447 40v Computer	12164-000	(TI)* C447
CR2		Same as CR1		
CR3	2	Diode, Germanium IN34A 60v, Gen. Purpose	12104-003	(Sy)* IN34A
CR4		Same as CR1		
CR5		Same as CR3		
CR6		Same as CR1		
CR7		Same as CR1		
CR8		Same as CR1		
CR9	3	Diode, Silicon, A-100, Power	12194-003	(Ma)* A100
CR10	1	Diode, Silicon, 1N1520, Zener 5.6v, 1 w, 10%	12154-000	(GI)* IN1520
CR11	8	Diode, Silicon, 1N2481, Power	12194-001	(ST)* IN2483
CR12		Same as CR11		
CR13		Same as CR11		
CR14		Same as CR11		
CR15		Same as CR11		
CR16		Same as CR11		
CR17	3	Diode, Silicon, 1N2484, Power	12194-002	(ST) IN2484
CR18		Same as CR17		
CR19		Same as CR17		
CR20		Same as CR11		
CR21		Same as CR11		
CR22		Same as CR9		
CR23		Same as CR9		
CR24	1	Same as CR1		
F1	1	Fuse, 5a, Fast Blow	15470-000	(Bu)* MTH-5
L1	3	Inductor, 15 μh, Phenolic core	14284-000	(Wi)* 1015-15-150
L2		Same as L1		
L3		Same as L1		
L4	2	Inductor, 25 μh, Phenolic core	14284-001	(Wi) 102-15-150
L5		Same as L4		
L6	4	Not Used		
L7		Inductor, 1 μh Phenolic core	14284-002	(Wi) 205-11-10
L8		Same as L7		
L9		Same as L7		
L10		Not Used		
L11		Same as L7		
S1	1	Switch, PB, Mom. Cont. 10a, 115v	15300-000	(Gr)* 2201 NO.
S2	1	Switch, Toggle, SPST, 3a, 250v	15280-000	(AHH)* 20994-LH

*-(MC)-Mag. Comp. - (TI)-Texas Instr. - (Sy)-Sylvania - (Ma)-Mallory - (GI)-Gen. Instr. - (ST)-Sarkes-Tarzian - (Bu)-Bussman - (Wi)-Wilco - (Gr)-Grayhill - AHH)-Arrow, Hart & Hegeman

5.5 MISCELLANEOUS (Cont.)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	(MFR.) & MFR'S PART NO.
S3	1	Switch, Oscillator Range	37000-005	(DpI)*
S4	1	Switch, Delay	37000-006	(DpI)
S5	1	Switch, Width	37000-007	(DpI)
S6	1	Switch, Rotary, 3 position, 1 sec., 30°, conc., shorting	25250-000	(OM)* 218736-N1
S7	1	Switch, Rotary, 6 position, 1 sec., 60°, conc., shorting	25250-001	(OM) 218738-K1
S8	1	Switch, Rotary, 6 position, 1 sec., 60°, conc., shorting	25250-002	(OM) 218739-K1
T1				
T2	1	Transformer, Fil., F13X, 6.3v, .6a	14050-000	(Tr)* F13X
T3	3	Transformer, Pulse, 1:1 Ratio	37000-003	(DpI)
T4		Same as T3		
T5		Same as T3		
T6	7	Transformer, Pulse, 2:1 Ratio	37000-004	(DpI)
T7		Same as T6		
T8		Same as T6		
T9		Same as T6		
T10		Same as T6		
T11		Same as T6		
T12		Same as T6		

*=(DpI)-Datapulse, Inc. - (OM)-Oak Mfg. - (Tr)-Triad

APPENDIX A

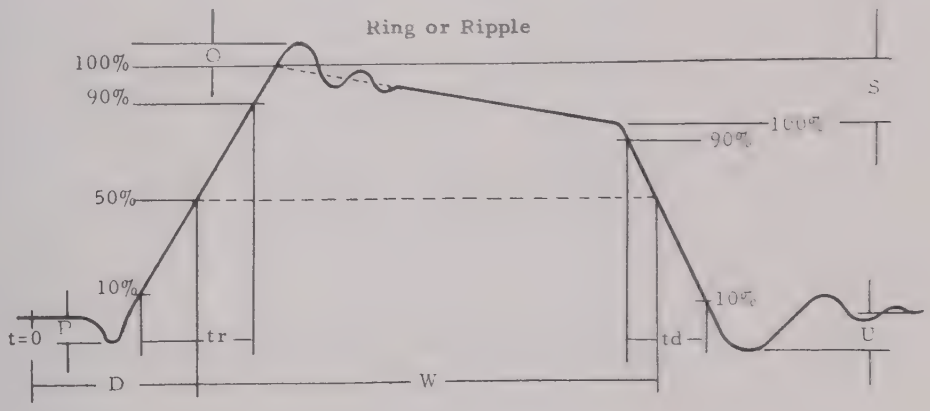
ABBREVIATIONS • SYMBOLS • TERMINOLOGY

A pulse is defined as a momentary, sharp change in current, voltage or other quantity that is normally constant. Simply stated, a pulse may be considered as a transient change in dc voltage such as that caused when a switch is opened and closed. Since modern systems react at speeds nearly comparable to switching times, the exact characteristics of pulses and the performance to be expected of pulse generators is very important.

A pulse is characterized by a rise and a decay and has a finite duration. The definitions of these and other pulse characteristics are somewhat arbitrary but are generally accepted as indicated in Figure 1. In Figure 1, "tr" is the rise or leading edge time. This is the time between the 10% and 90% amplitude points on the leading edge of either positive or negative pulses. Decay time, "t_d", often referred to as "fall time" is the time between the 90% and 10% amplitude points on the trailing edge of both positive and negative pulses. "W" is the pulse width or duration and is measured from the 50% point on the leading edge to the corresponding point on the trailing edge. "D" is the delay from a reference and is measured from the 50% point on the leading edge of the sync to the 50% point on the leading edge of the output pulse. "S" is the top slope and is usually expressed in percent of leading edge 100% amplitude, as is the overshoot "O". Undershoot, "U", is a damped oscillation occurring at the completion of decay time.

Several additional terms frequently encountered include: "Jitter -- a variation in time of any pulse parameter from cycle to cycle; "Pulse Width Duty Cycle"-- the percentage ratio of the pulse duration to the period of the pulse signals; "Resolution"--- the smallest, definable increment of a given figure.

D=Delay
W=Pulse Width
tr=Rise Time
O=Overshoot
S=Top Slope
td=Decay Time
U=Undershoot
P=Preshoot



Capacitive Loads

Required source impedance (Zo) for driving a circuit is given by the equation

$$Zo = \frac{tr}{2.2C}$$

where tr is the rise time required and C is the input capacity of the circuit driven. From this it is readily apparent that the input admittance of an oscilloscope probe precludes observation of high impedance phenomenon without alterations in both amplitude and rise time.

Oscilloscope Response

In the area of oscilloscope observation, one must note the effect of the vertical amplifier response of the oscilloscope upon rise time observation.

$$t_{obs} = \sqrt{t_{in}^2 + t_{scope}^2}$$

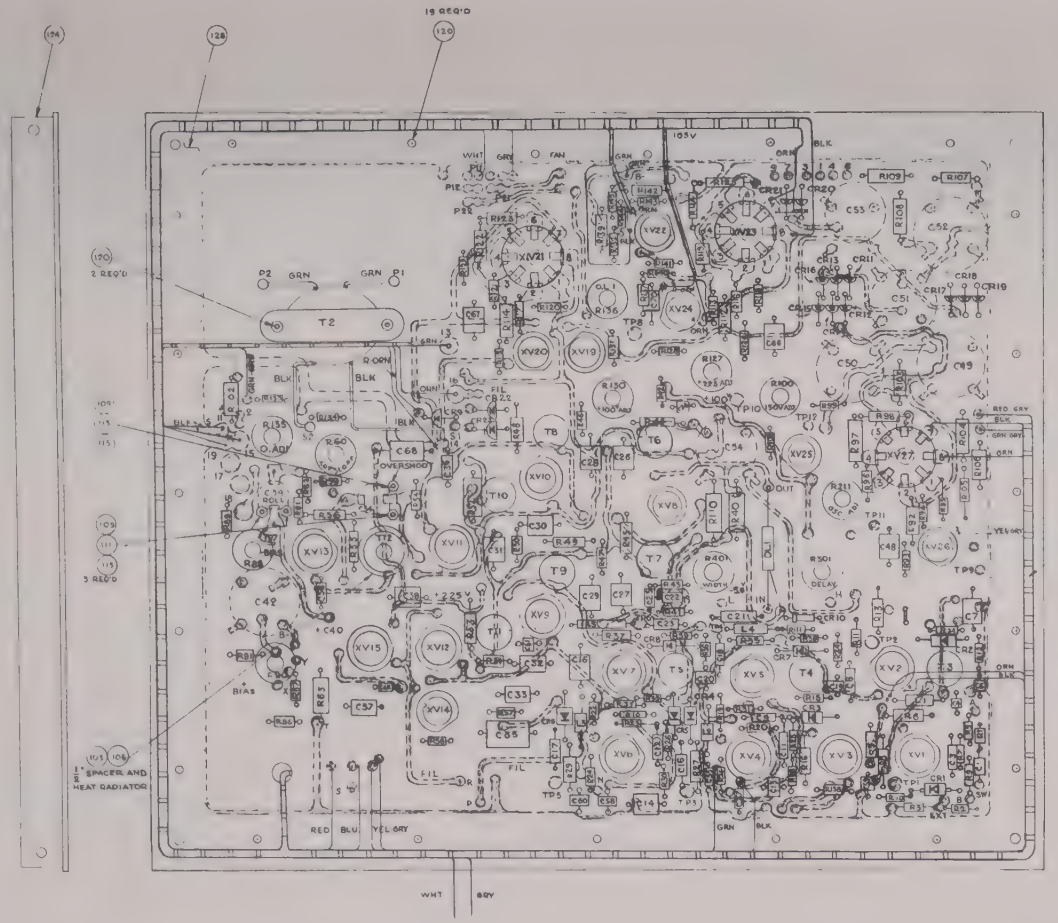
gives the relationship of observed rise time, scope rise time, and actual rise time. This equation may be written:

$$t_{in} = \sqrt{t_{obs}^2 - t_{scope}^2}$$

For example, given vertical amplifier response of 15 nanoseconds and a rise time is observed to be 18 nanoseconds, then the actual rise time

$$t_{in} = \sqrt{18^2 - 15^2}$$

or approximately 10 nanoseconds while an observed 16 nanoseconds would be an actual 5 nanoseconds (twice as fast). It is then apparent that for observations of phenomenon in the region of 10 nanoseconds and less, resolution of most oscilloscopes is not sufficient for actual comparison. Two solutions present themselves. First is the use of a traveling wave oscilloscope or if the phenomena is reoccurring, a sampling technique. The second is a method of displaying the desired signal directly upon the deflection plates of the oscilloscope. Most manufacturers such as Tektronix, Dumont, and Hewlett-Packard have this feature available.



RESISTORS

REF/DES	ITEM NO	VALUE
R1	21	47Ω
R2	6	10K
R3	6	10K
R5	1	100Ω 5% 1W
R6	31	15K 1W
R7	14	22K
R8	38	1 KPW
R9	5	1M
R10	10	180K
R11	18	33K
R12	21	47Ω
R13	34	470Ω 1/2W
R14	12	220Ω
R15	5	1K
R16	34	470Ω 1/2W
R19	7	100K
R20	16	27K
R21	2	47Ω 5% 1W
R22	7	100K
R23	16	27K
R24	2	47Ω 5%
R25	6	10K
R26	6	10K
R27	43	470Ω 1/2W
R28	17	270Ω
R29	43	470Ω 1/2W
R30	17	270Ω
R31	3	2.2K
R32	5	1K
R33	13	1.2K
R34	21	47Ω
R35	34	470Ω 1/2W
R36	21	47Ω
R37	34	470Ω 1/2W
R38	12	220Ω
R39	5	1K
R40	43	470Ω 1/2W
R41	8	3.3K
R42	21	47Ω
R43	2	47Ω
R44	43	470Ω 1/2W
R45	43	470Ω 1/2W
R46	21	47Ω
R47	21	47Ω
R48	43	470Ω 1/2W
R49	43	470Ω 1/2W
R50	21	47Ω
R51	21	47Ω
R52	43	470Ω 1/2W
R53	43	470Ω 1/2W
R54	11	1.2K
R55	44	1500Ω 2W
R56	44	1500Ω 2W
R57	20	2.2Ω
R58	11	2.2Ω
R59	15	220K
R60	45	100K 2W
R61	7	100K
R62	26	68K
R63	39	10K 2W
R64	41	330Ω 5% 1/2W
R65	7	100K
R67	7	100K
R68	45	220K 1/2W
R89	-	100K
R92	45	220K 1/2W
R91	7	100K
R92	30	100Ω 1W
R93	7	100K
R94	8	1M
R95	21	47Ω

RESISTORS

REF/DES	ITEM NO	VALUE
R96	21	47Ω
R97	32	22Ω 1W
R98	32	22Ω 1W
R99	7	100K
R100	45	2.2Ω 5% 2W
R101	24	56K
R102	35	2.2Ω 1W
R103	32	22K 1W
R104	42	33K 2W
R105	42	33K 2W
R106	42	33K 2W
R107	32	22K 1W
R108	38	1K 2W
R109	38	1K 2W
R110	40	1250Ω 5% 10W
R111	40	1250Ω 5% 10W
R112	30	100K 1W
R113	30	100K 1W
R114	30	100K 1W
R115	30	100K 1W
R116	8	1M
R117	8	1M
R118	21	47Ω
R119	21	47Ω
R120	21	47Ω
R121	21	47Ω
R122	32	22K 1W
R123	32	22K 1W
R124	32	22K 1W
R125	32	22K 1W
R126	23	470Ω 1/2W
R127	45	2.2K 2W
R128	7	100K
R129	7	100K
R130	45	2.2K 2W
R131	7	100K
R132	15	220K
R133	9	1.5M
R134	7	100K
R135	45	2.2K 2W
R136	45	2.2K 2W
R137	15	220K
R138	19	3.9K
R139	29	10K 1W
R140	23	470Ω 1/2W
R141	25	680K
R142	29	10K 1W
R143	23	470Ω 1/2W
R144	25	680K
R145	21	47Ω
R211	45	2.2K 2W
R301	45	2.2K 2W
R401	45	2.2K 2W

CAPACITORS

REF/DES	ITEM NO	VALUE
C1	61	.01μf
C2	59	.1μf
C3	50	27
C4	61	.01μf
C5	48	100
C6	61	.01μf
C7	59	.1μf
C8	47	470 50v
C9	51	47
C10	51	47
C11	49	15
C12	49	15
C13	61	.01μf
C14	59	.1μf
C15	59	.1μf
C16	51	47
C17	51	47
C18	47	470 200v
C19	81	.005μf
C20	61	.01μf
C21	54	1000
C22	61	.01μf
C23	47	470 300v
C24	61	.01μf
C25	61	.01μf
C26	59	.1μf
C27	59	.1μf
C28	59	.1μf
C30	59	.1μf
C31	59	.1μf
C32	59	.1μf
C33	59	.1μf
C36	57	.5μf
C36	59	.1μf
C37	59	.1μf
C38	59	.1μf
C44	61	.01μf
C48	59	.1μf
C55	81	.005μf
C56	61	.01μf
C57	61	.01μf
C58	61	.01μf
C59	61	.01μf
C60	61	.01μf
C61	61	.01μf
C62	61	.01μf
C66	59	.1μf
C67	59	.1μf
C68	59	.1μf
C70	59	.1μf

TUBE SOCKETS

REF/DES	ITEM NO	VALUE
XV1	100	9-338
XV2	97	9-316
XV3	99	9-160
XV4	100	9-338
XV5	97	9-316
XV6	100	9-338
XV7	97	9-316
XV8	103	9-NO
XV9	101	9-320
XV10	101	9-320
XV11	98	9-327
XV12	98	9-327
XV13	98	9-327
XV14	98	9-327
XV15	98	9-327
XV19	92	7-NO
XV20	91	7-327
XV21	84	8-NO
XV22	102	9-170
XV23	94	8-NO
XV24	103	9-NO
XV25	92	7-NO
XV26	91	7-327
XV27	94	8-NO

DIODES

REF/DES	ITEM NO	VALUE
CR1	74	1N34A
CR2	74	1N34A
CR3	74	1N34A
CR4	74	1N34A
CR5	74	1N34A
CR6	74	1N34A
CR7	74	1N34A
CR8	74	1N34A
CR9	78	HV2482
CR10	76	1N1520
CR11	79	1N2483
CR12	79	1N2486
CR13	79	1N2483
CR14	79	1N2483
CR15	79	1N2483
CR16	79	1N2483
CR17	80	1N2484
CR18	80	1N2484
CR19	80	1N2484
CR20	79	1N2483
CR21	79	1N2483
CR22	78	1N1461
CR23	78	1N2482

TEST LUGS

TP1	122	
TP2	22	
TP3	122	
TP4	122	
TP5	22	
TP6	22	
TP7	22	
TP8	122	
TP9	22	
TP10	22	
TP11	122	
TP12	22	

TRANSFORMERS

T2	83	PWR
T3	125	1:1
T4	125	1:1
T5	123	1:1
T6	126	2:1
T7	126	2:1
T8	126	2:1
T9	126	2:1
T10	126	2:1
T11	126	2:1
T12	126	2:1

INDUCTORS

L1	87	15μH
L2	87	15μH
L3	87	15μH
L4	88	25μH
L5	88	25μH

DELAY LINE

DL1	85	1.09μ 1500Ω

REQD	PART NO.	DESCRIPTION	ITEM

LIST OF MATERIALS

FOR PART REQUIREMENTS SEE LIST OF MAT'L 37000-002

NOTE: UNLESS OTHERWISE SPECIFIED,

1. DOTTED LINES INDICATE COMPONENTS ON OTHER SIDE.
2. ALL RESISTOR VALUES ARE ½W 10%
3. ALL CAPACITOR VALUES ARE IN μμf

37000-002	M-102	1
NEXT ASSY	USED ON	NEXT ASSY / FINAL ASSY
APPLICATION		QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON 2 PLACE DEC ± 3 PLACE DEC ± ANGLES ± MATERIAL FINISH

DRAWN G. Gougeon 9 8 61
CHECKED OK Owl
APPROVED M.A. Stoneman
APPROVED
APPROVED
RELEASED

DO NOT SCALE DWG.

TITLE: SUBASSEMBLY - CIRCUIT BOARD FACE SIDE MODEL 102

SCALE 1:1

DATAPULSE DATAPULSE, INC. HOLLYWOOD CALIFORNIA

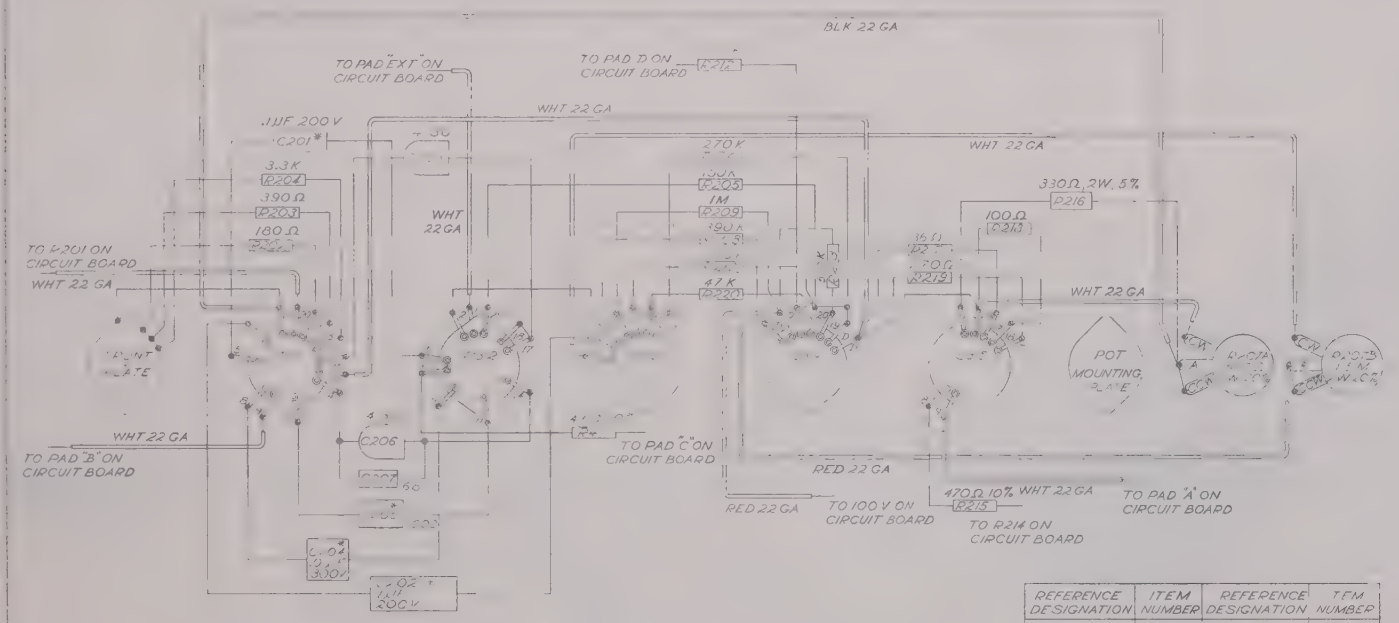
SIZE D · 37000-002

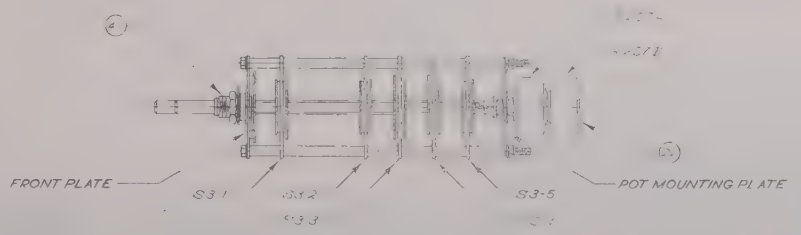
SHEET 1 OF 1

37000-002

REVISIONS

ECN	SYM	DESCRIPTION	DATE	APPROVAL





REFERENCE DESIGNATION	ITEM NUMBER	REFERENCE DESIGNATION	ITEM NUMBER
R4	20	C201	37
R202	4	C202	38
R203	11	C203	34
R204	9	C204	23
R205	3	C205	31
R206	7	C206	34
R207 A&B	22	C207	25
R208	3		
R209	2		
R210	16		
R212	7		
R213	15		
R215	21		
R216	19		
R217	10		
R218	1		
R219	6		
R220	4		

FOR PART REQIREMENTS SEE LIST OF MATERIAL

37000-005

LIST OF MATERIALS

3. ALL CAPACITOR VALUES ARE IN UUF 500V 5%
2. ALL RESISTOR VALUES ARE ½ W 5%
1. * INDICATES COMPONENT VALUES MATCHED WITHIN 1% OF EACH OTHER.

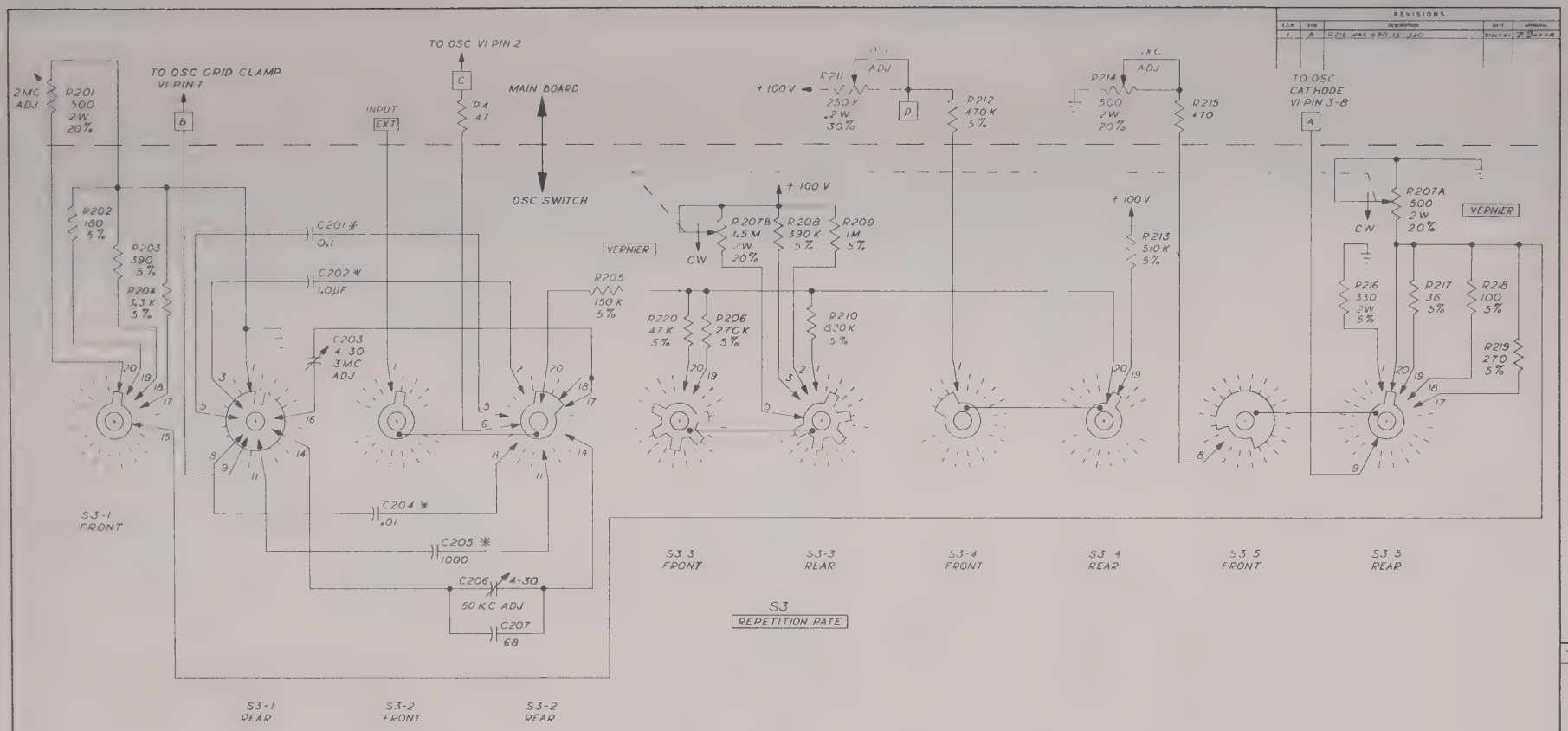
NOTES: UNLESS OTHERWISE SPECIFIED

S3 ASSEMBLY-OSCILLATOR RANGE SWITCH

MODEL 102

DATAPULSE INC. HAWTHORNE CALIFORNIA

37000-005 A



* INDICATES COMPONENT VALUES MATCHED WITHIN 1% OF EACH OTHER.

6. ROTOR BLADES OF SWITCH ARE SHOWN IN EXTREME CW POSITION (2MC)
5. BOXED LETTERS INDICATE SPECIFIC LABELED EYELETS ON CIRCUIT BOARD.
4. BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE.
3. ALL CAPACITOR VALUES LESS THAN ONE ARE IN µF.
2. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN µµF.
1. ALL RESISTOR VALUES ARE IN OHMS, ½W, 10%.

NOTES UNLESS OTHERWISE SPECIFIED

FOR PART REQUIREMENTS SEE LIST OF MATERIAL 37000-005

LIST OF MATERIALS

REVISIONS				
ECR	SYM	DESCRIPTION	DATE	APPROVAL
1	A	R216 WAS 680 IS 330	3 OCT 61	

REFERENCE DESIGNATIONS			APPLICATION		QTY REQD	
FIRST USED	LAST USED	OMIT TED	NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
C201 R201	C207 R220		H40000-000	MH02		

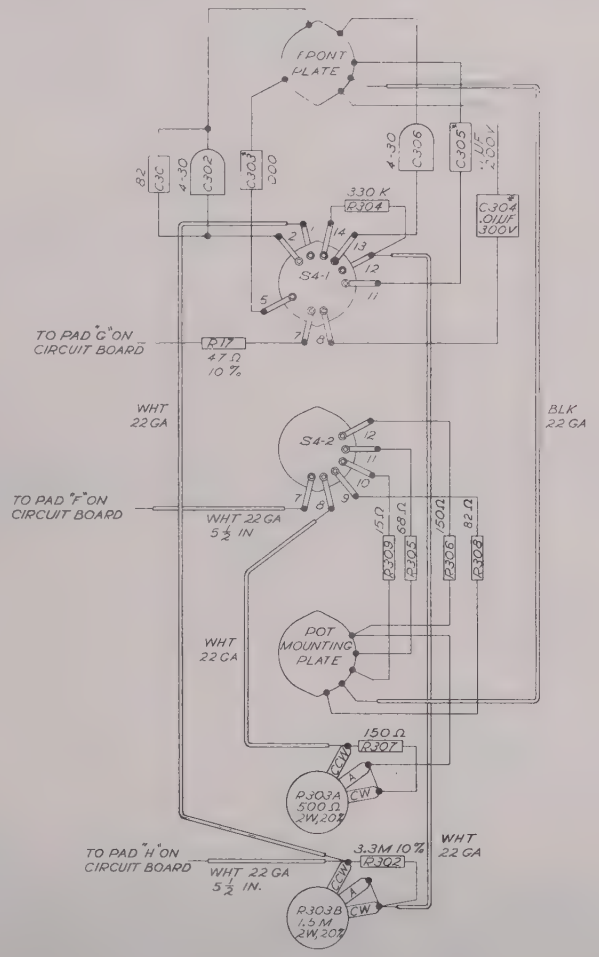
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON 1 PLACE DEC. ± 2 PLACE DEC. ± ANGLES ± MATERIAL FINISH DO NOT SCALE DWG.

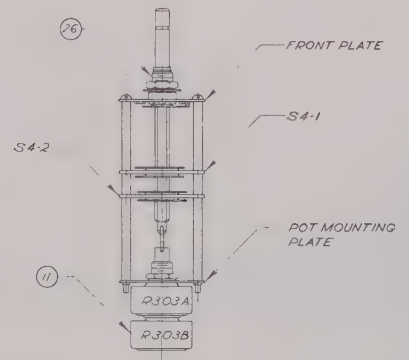
DRAWN GRANADOS 7/16/60
CHECKED J. SWITZER 30 Nov 61
APPROVED [illegible] 12 Dec 61
APPROVED [illegible]
APPROVED [illegible]
RELEASED [illegible] 20 Dec 61

TITLE SCHEMATIC 3MC OSCILLATOR SWITCH
MODEL 102
SCALE NONE

DATAPULSE INC. INGLEWOOD CALIFORNIA
DWG NO D 40000-001
SIZE
SHEET OF

40000-000 A





REFERENCE DESIGNATION	ITEM NUMBER
R1	3
R302	8
R303 A & B	11
R304	4
R305	5
R306	2
R307	2
R308	3
R309	1
C301	15
C302	19
C303	17
C304	16
C305	22
C306	19

REVISIONS				
E.C.N.	SYM	DESCRIPTION	DATE	APPROVAL
4	A	R308 IS 82 WAS 120	28 DEC 61	

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE ½W 5%.
2. ALL CAPACITOR VALUES ARE IN μμF 500V 5%.
3. * INDICATES COMPONENT VALUES MATCHED WITHIN 1% OF EACH OTHER.

FOR PART REQUIREMENTS SEE LIST OF MATERIAL 37000-006

LIST OF MATERIALS

REQD	PART NO.	DESCRIPTION	ITEM

37000-009	M-102	1			
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY	QTY REQD	
APPLICATION				DO NOT SCALE DWG.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
3 PLACE DEC. ± | 2 PLACE DEC. ± | ANGLES ±
MATERIAL
FINISH

DRAWN G. PANADOS 8 SEP 61
CHECKED 8 Sep 61
APPROVED 11 Sep 61
APPROVED
APPROVED
RELEASED 20 Sep 61

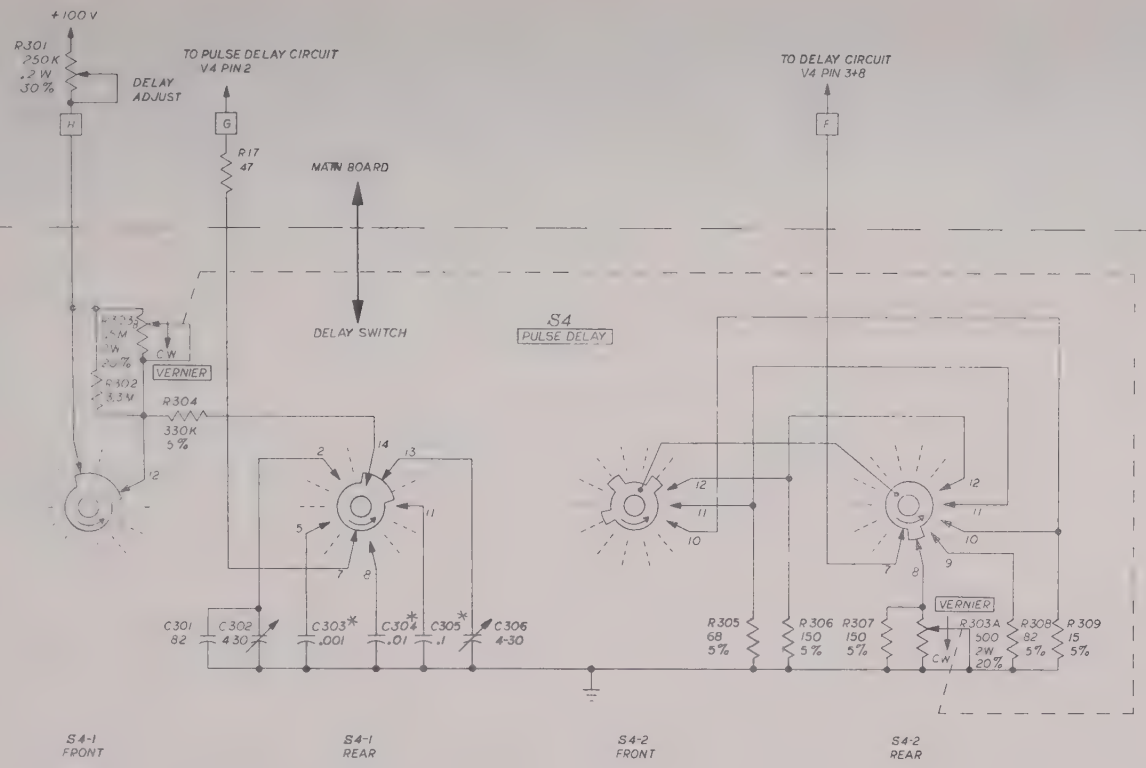
TITLE: S4 ASSEMBLY - PULSE DELAY SWITCH
MODEL-102
SCALE NONE

DATAPULSE
DATAPULSE, INC.
INGLEWOOD, CALIFORNIA

SIZE D | 37000-006
SHEET 1 OF 1

37000-006 | A

REVISIONS				
ECA	STK	DESCRIPTION	DATE	APPROVAL
4	A	R308 IS 82 WAS 120	28 DEC 67	B Bursick



* INDICATES COMPONENT VALUES MATCHED WITHIN 1 % OF EACH OTHER.

FOR PART REQUIREMENTS SEE LIST OF MATERIAL 37000-006

REQD	PART NO.	DESCRIPTION	ITEM

LIST OF MATERIALS

8. NUMBERS SURROUNDING ROTOR BLADES INDICATE CONTACT NUMBERS.
7. ARROW ON ROTOR BLADE INDICATES CLOCKWISE ROTATION.
6. ROTOR BLADES OF SWITCH ARE SHOWN IN EXTREME CCW POSITION (0.5US).
5. BOXED LETTERS INDICATES SPECIFIC LABELED EYELETS ON CIRCUIT BOARD.
4. BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE.
3. ALL CAPACITOR VALUES LESS THAN ONE ARE IN µF.
2. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN µµF.
1. ALL RESISTOR VALUES ARE IN OHMS, ½ W, 10%.

NOTES: UNLESS OTHERWISE SPECIFIED

FIRST USED	LAST USED	OMITTED
C301 R301	C306 R309	

REFERENCE DESIGNATION

H40000-000M-102

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY

APPLICATION — QTY REQD

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES; TOLERANCES ON: 3 PLACE DEC. ±; 2 PLACE DEC. ±; ANGLES ±; MATERIAL; FINISH

DO NOT SCALE DWG.

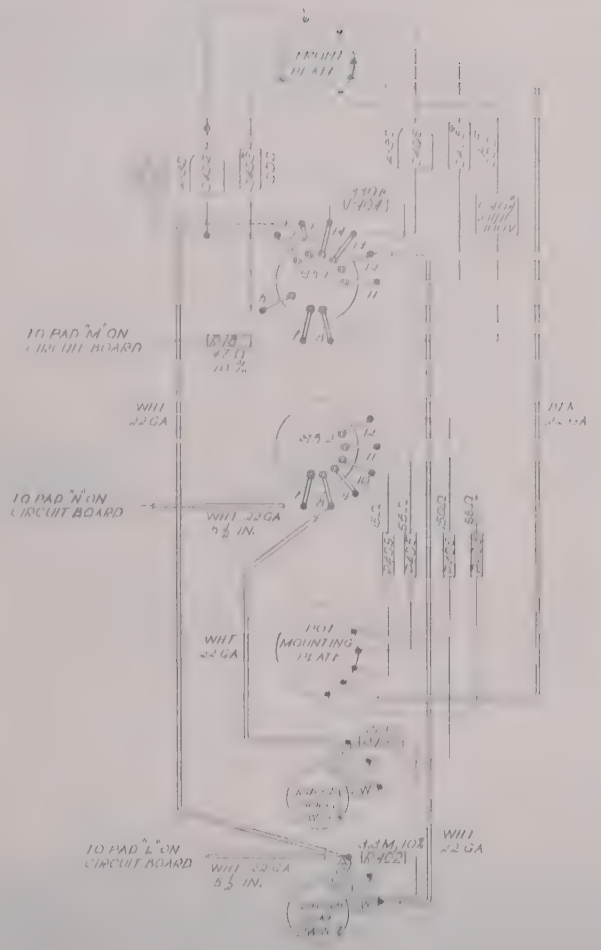
DRAWN: CRANADOS 7/16/68
CHECKED: B Bursick 28 Dec 67
APPROVED: M Dow 12 Sept 67
APPROVED: W A Schlosser 18 Sept 67
APPROVED:
RELEASED: B Bursick Date 6-7

TITLE: SCHEMATIC — PULSE DELAY SWITCH
MODEL 102
SCALE NONE

DATAPULSE INC. INGLEWOOD, CALIFORNIA

SIZE D 40000-002
SHEET 1 OF 1

40000-002 A


10 PAD "M" ON CIRCUIT BOARD
WHT 22 GA
10 PAD "N" ON CIRCUIT BOARD
WHT 22GA 7½ IN.
WHT 22 GA
POT (MOUNTING PLATE
10 PAD "L" ON CIRCUIT BOARD
WHT 22 GA 5½ IN.
WHT 22 GA

REFERENCE DESIGNATION	ITEM NUMBER
MAIN	9
MAIN	1
MAIN	11
MAIN	4
MAIN	5
MAIN	6
MAIN	7
MAIN	8
MAIN	1

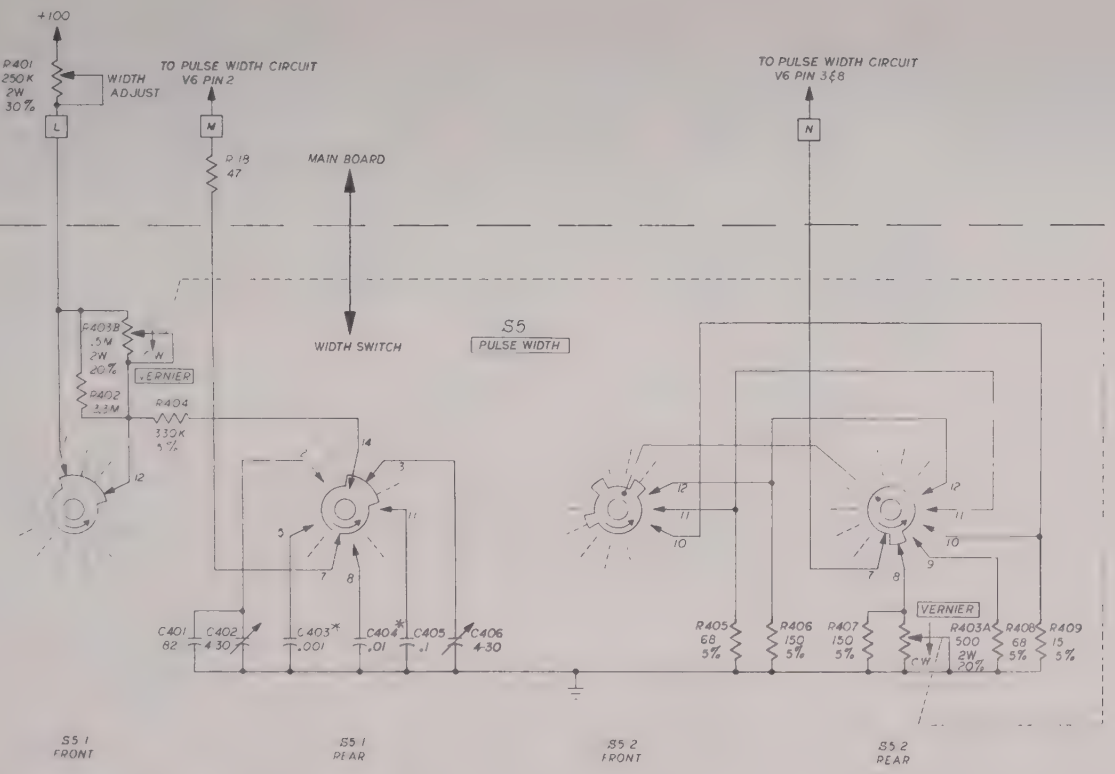
FOR PART REQUIREMENTS SEE LIST OF MATERIAL 37000-007

1. ALL CAPACITOR VALUES ARE IN μμf, 500V 5%.
2. ALL RESISTOR VALUES ARE ½W 5%.
3. * INDICATES COMPONENT VALUES MATCHED WITHIN 1% OF EACH OTHER.

PART NO.	DESCRIPTION	ITEM
	LIST OF MATERIALS	

	2-A ASSEMBLY PULSE WIDTH SWITCH
	MODEL 102

37000-007 4



* INDICATES COMPONENT VALUES MATCHED WITHIN 1% OF EACH OTHER.

8. NUMBERS SURROUNDING ROTOR BLADES INDICATE CONTACT NUMBERS.
7. ARROW ON ROTOR BLADE INDICATES CLOCKWISE ROTATION.
6. ROTOR BLADES OF SWITCH ARE SHOWN IN EXTREME CCW POSITION (.5US).
5. BOXED LETTERS INDICATE SPECIFIC LABELED EYELETS ON CIRCUIT BOARD.
4. BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE.
3. ALL CAPACITOR VALUES LESS THAN ONE ARE IN μF.
2. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN μμF.
1. ALL RESISTOR VALUES ARE IN OHMS ½W, 10%

NOTES: UNLESS OTHERWISE SPECIFIED

FOR PART REQUIREMENTS SEE LIST OF MATERIAL 37000-007

LIST OF MATERIALS

REVISIONS				
ECR	SYM	DESCRIPTION	DATE	APPROVAL
4	A	R408 IS 68 WAS 120	3/28/62	B Burks

REFERENCE DESIGNATION							
C401 R401	C406 R409		H40000-000	M 102			
FIRST USED	LAST USED	OMITTED	ASSEMBLY DRAWING	USED ON	NEXT ASSY	FINAL ASSY	QTY REQ'D
APPLICATION							

DO NOT SCALE DWG.

DRAWN: GRANADOS 1/16/62
CHECKED: B Burks 2/8/62
APPROVED: [illegible] 2/9/62
APPROVED: [illegible]
RELEASED: B Burks 2/20/62

TITLE: SCHEMATIC — PULSE WIDTH SWITCH

MODEL 102

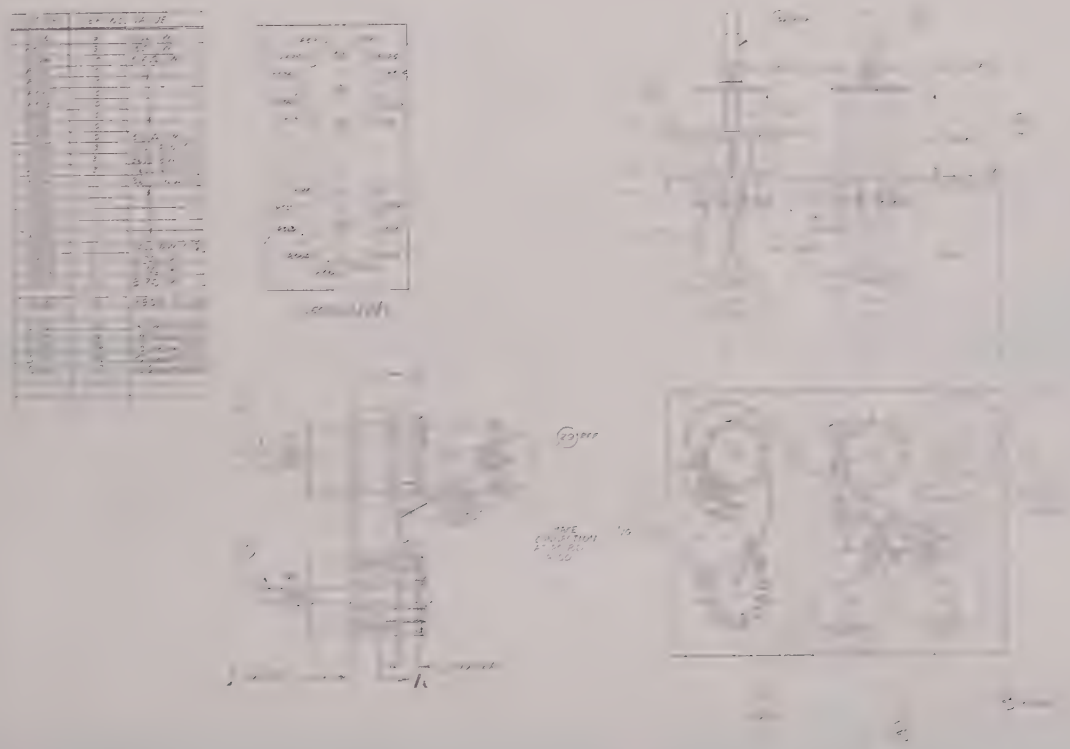
DATAPULSE INC. VENICE (CULVER CITY) CALIFORNIA

SIZE D | 40000-003

SCALE NONE

SHEET

40000-003 A



REVISIONS				
2	A	ADDED R575, R576, R577, R146 ADDED C73, C74, C75, C76, C501	2-9-61	B Burch

NOTES: UNLESS OTHERWISE SPECIFIED.

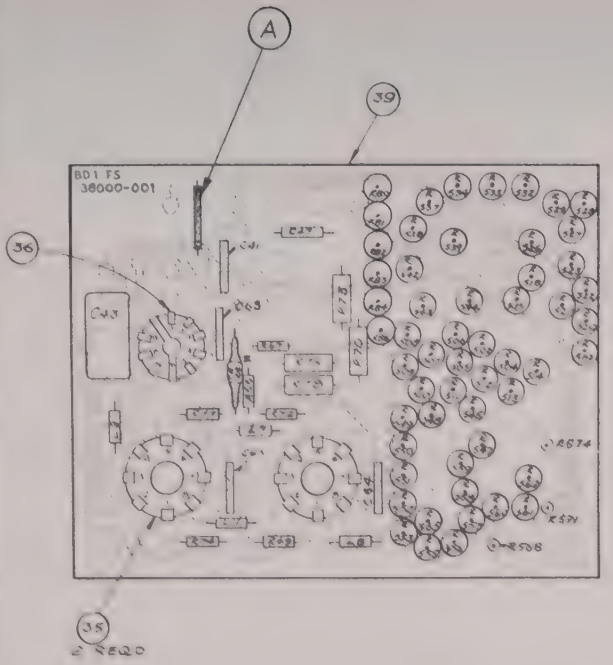
1. ALL RESISTOR VALUES ARE ½ W 10%
2. ALL CAPACITOR VALUES ARE IN MUF 500V 5%

MODEL	113
TITLE	REFRIGERATOR MUSIC OUTPUT AMPLIFIER
SIZE	D
DWG NO.	37000-000
SHEET	1 OF 1

37000-000 A

E.C.N.	SYM	DESCRIPTION	DATE	APPROVAL
4	A	REPLACED R79 10Ω 2W WITH A JUMPER	28 DEC 67	B Busich

REF DES.	ITEM NO.	VALUE	REF DES.	ITEM NO.	VALUE
R66	6	4.7K	R558	2	390Ω 2W 5%
R67	7	100K	R556		
R68	6	10Ω	R557		
R70	11	2.7Ω 1W	R558		
R72	6	10Ω	R559		
R73	11	2.7Ω 1W	R560		
R74	6	10Ω	R56		
R75	11	2.7Ω 1W	R562	2	390Ω 2W 5%
R76	6	10Ω	R565	3	47Ω 2W 5%
R78	11	2.7Ω 1W	R568	1	47Ω 5%
			R571	1	47Ω 5%
R80	17	500Ω 2W	R574	1	47Ω 5%
R81		500Ω 2W			
R82					
R83					
R84					
R85	17	150Ω 2W			
R502	21	47Ω 2W			
R504	15	10Ω 2W			
R505	15	10Ω 2W	C41	28	500 pF 5%
R506	15	10Ω 2W	C42	28	500 pF 5%
R507	19	2.7K 2W	C47	28	500
R508					
R509			C43	28	500 pF 5%
R510			C44	28	500 pF 5%
R511			C45	28	500 pF 5%
R512					
R513					
R514	19	2.7K 2W			
R515	15	10Ω 2W			
R518	15	10Ω 2W			
R519	16	1K 2W	CR 24	29	IN 144
R520	16	1K 2W			
R521	16	1K 2W			
R522	16	1K 2W			
R523	18	5K 2W			
R526	21	47Ω 2W			
R527	23	6800Ω 2W	L7	32	1.5 μH
R528	23	6800Ω 2W	L8	32	1.5 μH
R529	23	6800Ω 2W	L9	32	1.5 μH
R532	23	6800Ω 2W	L10	32	1.5 μH
R533					
R534					
R537					
R538					
R539					
R540					
R543					
R544	22	6800Ω 2W			
R545	4	2.7Ω 1W 5%			
R547					
R548					
R549					
R550					
R55					
R552					
R553	4	2.7Ω 1W 5%			



FOR PART REQUIREMENTS REFER TO LM 37000-001

REQD	PART NO.	DESCRIPTION	ITEM
		LIST OF MATERIALS	

1. ALL CAPACITOR VALUES ARE MMF 500V 5%
2. ALL RESISTOR VALUES ARE ½W 10%

NOTES: UNLESS OTHERWISE SPECIFIED

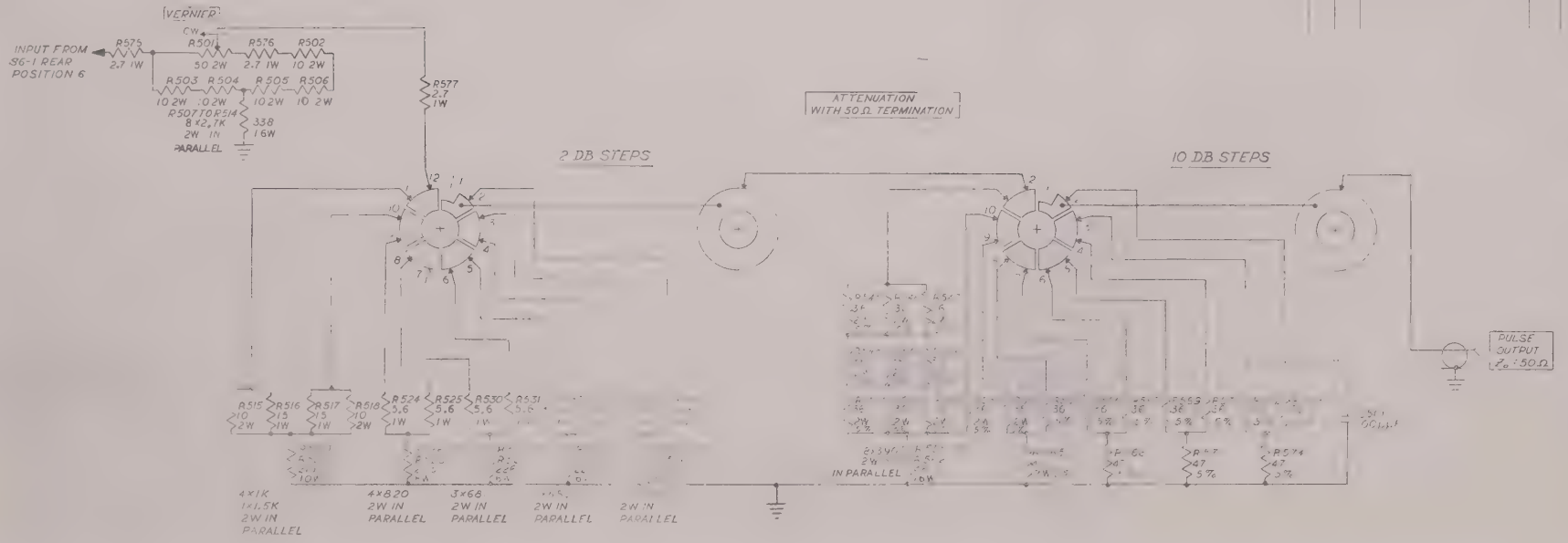
UNLESS OTHERWISE SPECIFIED	DRAWN	TITLE
DIMENSIONS ARE IN INCHES	C. A. Strohmeyer 1 Feb 68	SUB ASSEMBLY - BOARD NO 1
TOLERANCES ON	CHECKED	ATTENUATOR AND OUTPUT AMPLIFIER
3 PLACE DEC. ±	2 PLACE DEC. ±	ANGLES ±	APPROVED
MATERIAL	APPROVED	DATAPULSE, INC. INGLEWOOD, CALIFORNIA
FINISH	APPROVED	SIZE C — 37000-001
	RELEASED	SCALE — SHEET 1 OF 1

37000 ASSEMBLY NO.			
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

DO NOT SCALE DWG.

37000-001 A

REVISIONS				
LTR	SYM	DESCRIPTION	DATE	APPROVAL
4	A	R575, 576, 577, (2.7 1W) ADDED C501 (100 μμF) ADDED	28 DEC 61	R. Bucking



40000-004 A

FOR PART REQUIREMENTS SEE LIST OF MATERIAL 37000-000

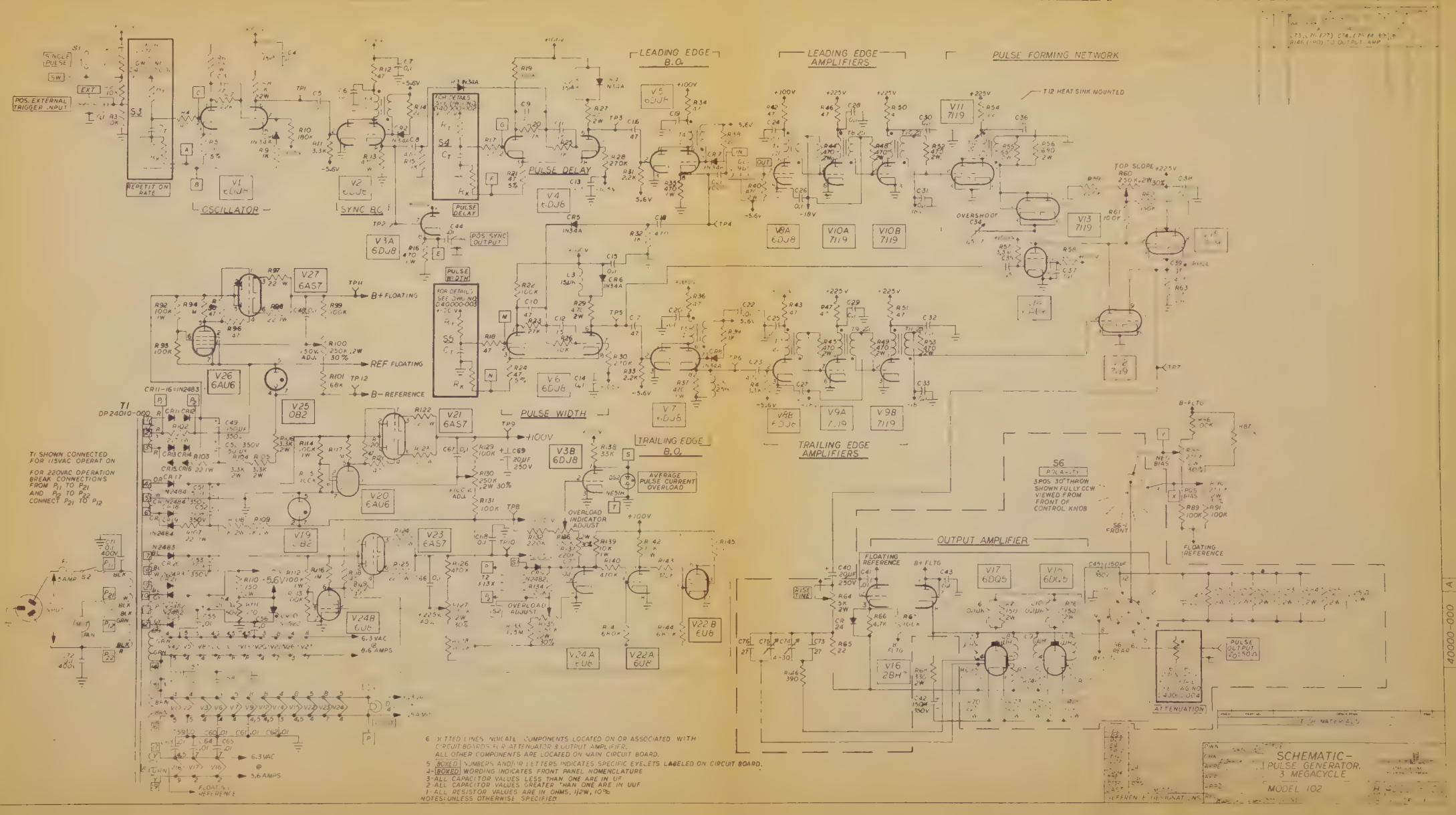
REQD	PART NO	DESCRIPTION	ITEM
		LIST OF MATERIALS	

2. ROTOR BLADES OF SWITCHES ARE SHOWN IN EXTREME CCW POSITION AS VIEWED FROM CONTROL KNOB
1. ALL RESISTOR VALUES ARE IN OHMS, ½W, 10%

NOTES: UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATION			APPLICATION		
FIRST USED	LAST USED	OMITTED	ASSOCIATED DWG	USED ON	NEXT ASSY QTY REQD
C501 R501	C501 R577		H40000-000	M-104 M-102	

DRAWN	11/16/61	TITLE SCHEMATIC ATTENUATOR 60DB 10W 10%	DATAPULSE DATAPULSE INC. INGLEWOOD, CALIFORNIA
CHK			
APPD			DWG 40000-004
APPD			SIZE D
APPD			SCALE NONE
RELEASED	11/28/61		SHEET 1 OF 1



6 DOTTED LINES INDICATE COMPONENTS LOCATED ON OR ASSOCIATED WITH CIRCUIT BOARDS FOR ATTENUATOR & OUTPUT AMPLIFIER. ALL OTHER COMPONENTS ARE LOCATED ON MAIN CIRCUIT BOARD.

5 BOXED NUMBERS AND/OR LETTERS INDICATES SPECIFIC EYELETS LABELED ON CIRCUIT BOARD.

4 BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE

3 ALL CAPACITOR VALUES LESS THAN ONE ARE IN UF

2 ALL CAPACITOR VALUES GREATER THAN ONE ARE IN UUF

1 ALL RESISTOR VALUES ARE IN OHMS, 1/2W, 10%

NOTES: UNLESS OTHERWISE SPECIFIED

Square wave generation into a 50Ω load: 50% (square wave) and even higher pulse output duty cycles may be achieved with the Model 102, into a 50Ω load, by utilizing adjustment potentiometers provided to decrease the +225 volt power supply output to +150 volts and the 150 volt supply output to 115 volts. Instructions for adjusting these power supplies, and location of the adjustments, may be found in the Instruction Manual (although those instructions do not contemplate this readjustment specified above). It will also be necessary to adjust positive output bias (R90) such that instrument is not in an overload condition. One may find it necessary to adjust top slope (R60) on wide pulses. With the power supplies readjusted in this fashion, the instrument can provide a positive going square wave of approximately 15 volts amplitude peak-to-peak, into a 50Ω load, at repetition rates to be at least 1 mc. Also, at this setting, outputs of decreased amplitude can be secured at even higher pulse width duty cycles, up to 10 volts into 50Ω at 80% pulse width duty cycle, at repetition rates below 1 mc.

The above detailed readjustments decrease the pulse amplitude generated by the instrument's pulse forming circuitry preceding the output stage to the point where the overload circuitry, which operates on the +225 voltage under overload conditions, does not cut in and out (to hold the output within its 225 mA limitation), thereby producing the apparent pulse amplitude jitter in the nonreadjusted unit.

High Current Output Into Low Impedance Loads:

When operating into a 50Ω load, the Model 102 provides slightly in excess of 1 ampere of peak output current. Certain applications, such as magnetic device evaluation or drive of many paralleled digital circuits, require higher output current into lower impedance loads. The standard instrument, without modification or readjustment of internal controls, will provide up to ± 15 volts into a 10Ω load, or 1.5 amperes peak. This performance may be achieved up to pulse width duty cycles of approximately 4%, with operation stable at correspondingly reduced amplitude (due to action of overload circuitry) up to pulse width duty cycles of approximately 10%. For best waveform, it will be found necessary to deteriorate the rise time to 12 to 14 nsec. and to readjust the internal flat top adjustmer

J. E. Niebuhr
Marketing Manager

Approved:

James S. Johnson
Engineering

DATAPULSE

APPLICATIONS BULLETIN
102-2

MULTIPLE PULSE GENERATION WITH MODEL 102 PULSE GENERATORS

Magnetic device testing, beacon development, and digital or other pulse code simulation often require multiple pulse or pulse train signals. Such applications need not require costly special purpose gear. Multiple DATAPULSE 102 Pulse Generators, properly connected, will satisfy a broad range of requirements.

Advantages of this method include: (1) lower cost--several 102's cost far less than a comparable special purpose unit; (2) greater versatility -- such a combination can be broken down into individual units for use on other projects; and (3) greater dependability -- unlike complex special purpose equipment, the 102 is simple, proven, and easily operated. In addition, individual control of all pulse parameters is available when using several 102's, and all pulses are selectable in polarity and amplitude, a feature not always available on expensive multi-pulse generators. Also, output power available is greater than in most special units.

OUTPUTS ON SEPARATE LINES

Connection as shown in Figure 1 is simple and effective and permits flexible control of the pulses. Repetition rate controls on Generators No. 2 and No. 3 are placed on EXTERNAL. Repetition rate is controlled from Generator No. 1. Pulse delay, width, polarity, amplitude and rise time are independently controlled over the normal range by the controls of the generator associated with that pulse.

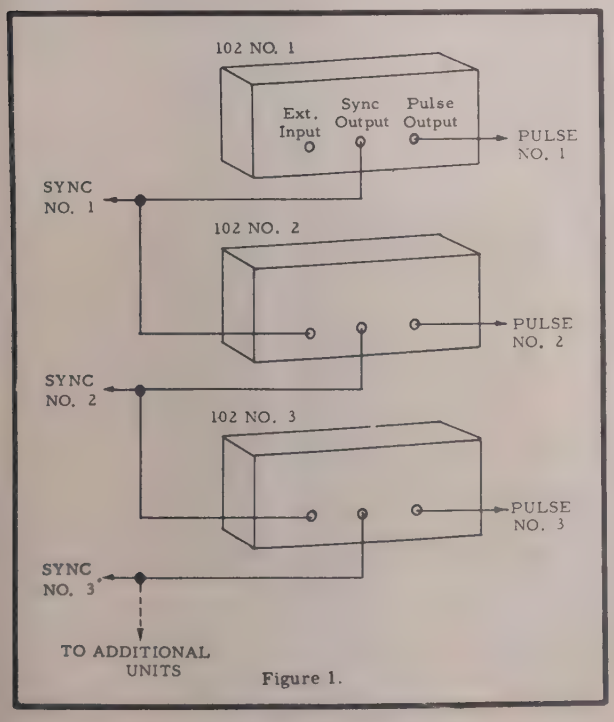


Figure 1.

Figure 2 presents the time relationships for the outputs when three 102's are connected together as in Figure 1. Note, that a nominal 15 nanosecond delay exists between sync outputs.

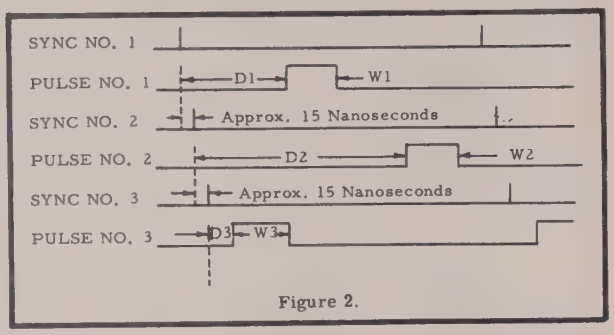


Figure 2.

OUTPUT ON A SINGLE LINE

For single line output, the outputs of the 102's may be mixed using coaxial tees as shown in Figure 3. The generators may be driven separately or in parallel from external sources or driven in tandem using the sync output of one generator to externally drive the next. Generator No. 1 (Fig. 3) also may be driven by an outside source in this arrangement, if sync with outside phenomena is desired.

Because of the fast rise character of the pulses and narrow widths available, pulse repetition rates exceeding 10 mc may be synthesized (see Figure 13).

Output waveform with this connection is a function of termination of interconnecting cables. With improper termination, reflections occur which cause wave shape deterioration and increased rise time. Several methods of mixing with results obtained are discussed below.

MIXING METHODS

The method shown in Figure 3 provides the greatest pulse amplitude, but due to cable mismatching, considerable waveform distortion, particularly overshoot on positive pulses, may present itself. Also, minimum rise times may be increased by a factor of two or more, depending on length of connecting cables. Results of this method are shown in Figures 5a and 5b.

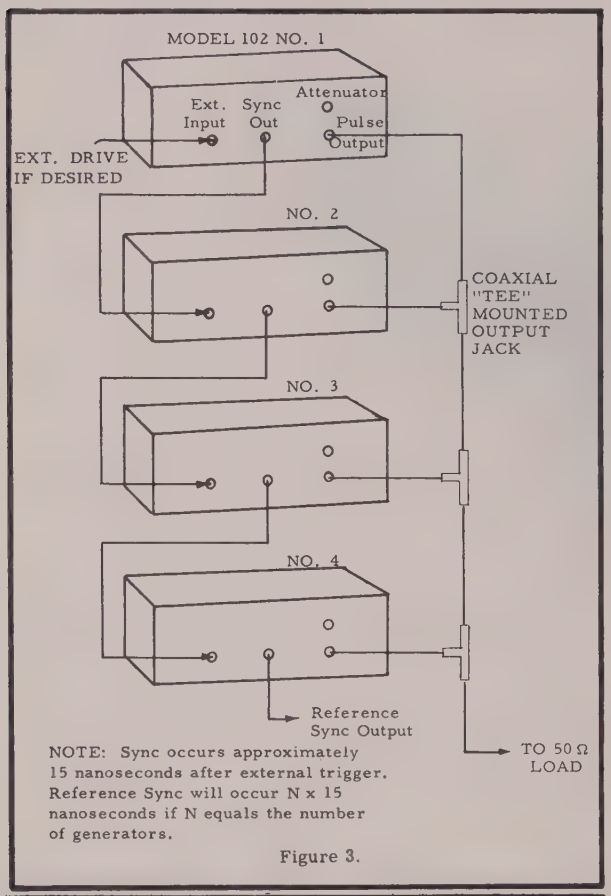
The use of a mixing pad, as shown in Figure 4, has been suggested, but is not satisfactory. Although this method does reduce overshoot, it is accompanied by considerable leading and lagging edge distortion, as shown in Figures 6a and 6b.

Best results in the area of waveform fidelity are obtained by inserting some measure of attenuation (the amount varying with the number of generators) at the generator end by using the internal attenuator.

(CONTINUED)

With a characteristic impedance of 50 ohms, the internal attenuator tends to terminate the connecting cable, yielding much less waveform distortion. Of course, this is accomplished at the expense of less amplitude. Figures 7a and 7b show the effect of 2 db attenuation; Figures 8a and 8b show the effect of 4 db.

Figures 9 - 13 show waveform possibilities with three generators each set at 6 db. Tektronix 581 with Type "L" plug-in (7 nanoseconds rated rise) was used.



NOTE: Sync occurs approximately 15 nanoseconds after external trigger. Reference Sync will occur N x 15 nanoseconds if N equals the number of generators.

Figure 3.

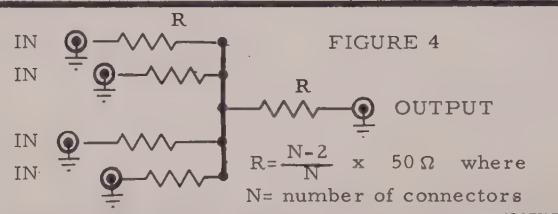
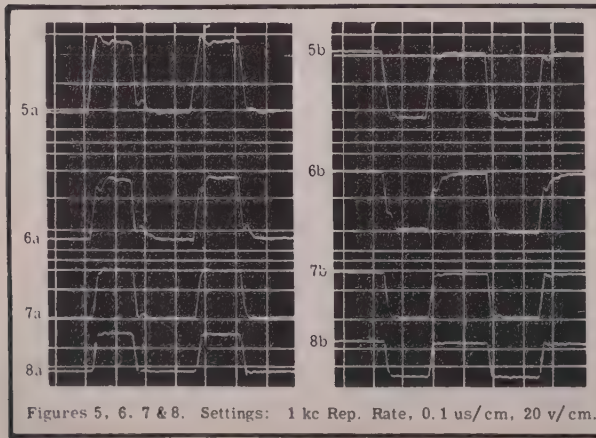


FIGURE 4



Figures 5, 6, 7 & 8. Settings: 1 kc Rep. Rate, 0.1 us/cm, 20 v/cm.

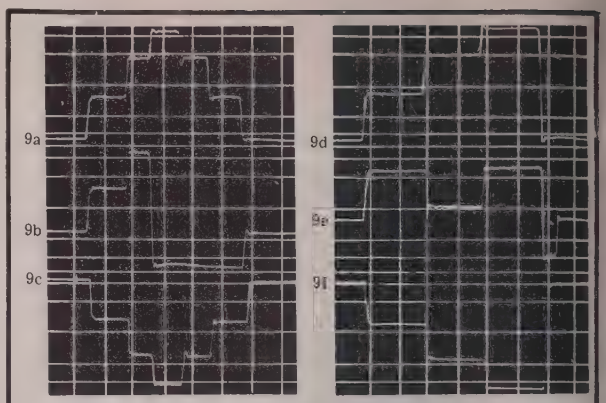


Figure 9. Three Superimposed Pulses.
Settings: 1 kc Rep. Rate, 0.2 us/cm, 10 v/cm.

9a: Three Pos. Pulses
9b: Two Pos. and One Neg.
9c: Three Neg. Pulses
9d: Three Pos. in Staircase Array
9e: Two Pos. and One Neg.
9f: Three Neg. in Staircase Array

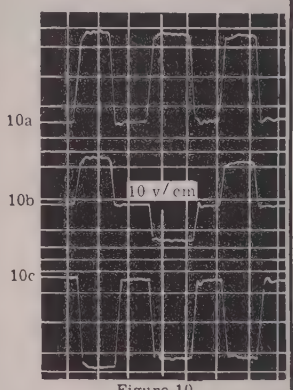


Figure 10.
Three Pulses (not superimposed)
Settings: 1 kc Rep. Rate, 0.1 us/cm, 5 v/cm.

10a: Three Pos. Pulses Approx. 0.1 us wide.
10b: Two Pos. and One Neg.
10c: Three Neg. Pulses Approx. 0.1 us wide.

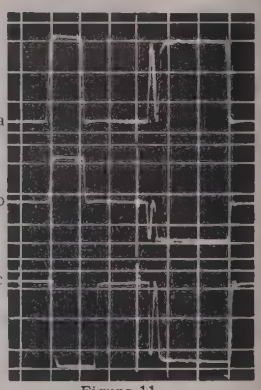


Figure 11.
Variations in Coding
Settings: 1 kc Rep. Rate, 0.2 us/cm, 5v/cm.

11a: Three Pos. Pulses -- Two wide, one narrow with very little separation between the two.
11b: One Pos. and Two Neg.
11c: Three Neg. Pulses.

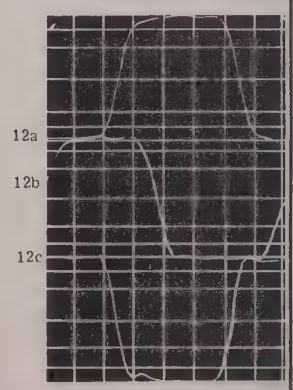


Figure 12.
Rise and Fall Time of Various Pulse Configurations.
Setting: 0.02 us/cm
12a: One Pos. Pulse.
12b: Pos. and Neg. Pulse with Lagging and Leading Edges Coincident.
12c: One Neg. Pulse.

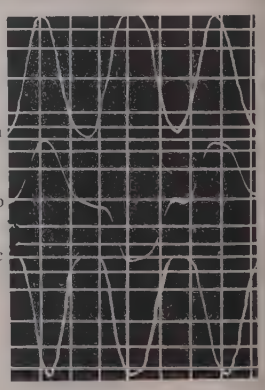


Figure 13.
High Rep. Rate Synthesis
Setting: 0.02 us/cm
13a: Three Pos. Pulses.
13b: Two Pos. and One Neg.
13c: Three Neg. Pulses.

DATAPULSE

APPLICATIONS BULLETIN

102-3

MODEL 102 OVERLOAD PROTECTION

Specifications of the Model 102 Pulse Generator lead to the expectation of 22.5% pulse width duty cycle capability at maximum output amplitude (output of 50 V peak into 50 ohms and 225 ma maximum average output current). However, the positive pulse baseline specification of "less than 0.5 V" is a steady drain of 10 ma and it will be found that output amplitude exceeds 50 V sufficiently to decrease the actual duty cycle capability to 18 to 20%.

Note also that decreasing the output amplitude does not increase the pulse width duty cycle capability, since the output amplitude is reduced by a constant impedance output attenuator, which leaves the instrument always producing the same output power and simply drains off a part of this power.

When the duty cycle capability of the instrument is exceeded, control circuitry takes over to reduce the amplitude of a large enough percentage of output pulses to bring the average current down to 225 ma. This results in an apparent amplitude jitter (due to the sampling and correcting action) when the unit is in an overload condition, which does not allow operation at excessive duty cycle with stably decreased amplitude. (For information on operation at extended duty cycles to 50% and higher, see Applications Bulletin No. 102-1).

The overload indicator is activated by the overload protection circuitry, up to pulse width duty cycles where the unit's pulse width control circuitry fails (somewhere past 70% duty cycle). Beyond this point, the overload protection circuitry no longer operates since the drive signal to the output stage is skipping, low in amplitude, or missing entirely and the unit is therefore not trying to pass more than its rated 225 ma through the output stage. In this condition, of course, the overload indicator does not indicate an overload condition. If the duty cycle is then decreased to the point where the pulse width circuitry agains begins to operate, the overload indicator again operates.

Any question as to whether the overload indicator is operating properly may easily be resolved by increasing the duty cycle to the point where output pulse amplitude jitter just begins to occur. At this point, the overload indicator should operate. If not, adjust the internal Overload Indicator Adjustment per Instruction Manual calibration instructions.

The adjustment procedure for overload protection circuitry detailed in the Instruction Manual calls for an actual measurement of the average output current passing through the output tubes. This may usually be successfully shortened by simply setting the unit to an 18% pulse width duty cycle (at a repetition rate of 1 mc or less) and setting the internal Overload Adjustment to the point where the output amplitude jitter just begins to occur. Be sure to set the internal Output Stage Bias Adjustments per the procedure on Page 25 of the Manual prior to adjusting overload. If any question remains as correctness of the overload adjustment, follow the detail procedure indicated on Page 26 of the Manual.

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DATAPULSE

APPLICATIONS BULLETIN

No. 102-4

OUTPUT AT GROUND

The positive pulse output of the DATAPULSE Model 102 is specified with baseline nominally around ground, that is, less the +0.5v.

Some applications, such as certain diode tests, require a baseline more near ground. This may be accomplished on the 102 by (1) increasing output bias or (2) using a dc offset.

Both of the above methods have advantages. Use the method best suited to your requirements.

INCREASING OUTPUT BIAS

This method of adjusting baseline dc level may be accomplished by resetting two internal adjustments.

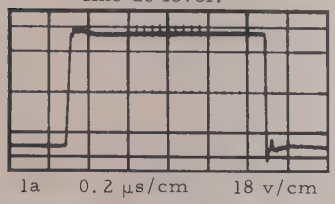
1. With the polarity switch set on POSITIVE, set the 150v supply to 120v by means of R100 (150v Adj.).
2. Set the repetition rate control to EXT. and observe the dc level at the pulse output jack.
3. Adjust R90 (Pos. Bias) for the required baseline dc level.

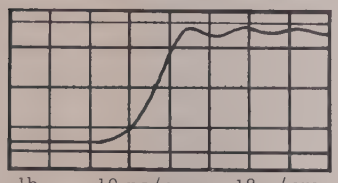
Excellent waveform may be obtained with this method; however, since the output tubes are not being driven as firmly (due to increased bias), rise time is increased to approx. 15 nanoseconds and the output amplitude is reduced by approx. 20%. See Figures 1 and 2.

DC OFFSET VOLTAGE

This method will improve waveform character, but it requires an outside dc source connected as shown in Figure 4. With connections shown in Figure 4 made, place the repetition rate control on EXT., the polarity switch on POSITIVE and observe the dc level at the output jack. Adjust the dc offset voltage until desired baseline dc level is obtained.

Better waveform is obtained than when using the bias shift method, and since the output is driven firmly, negligible increase is noticed in rise time. A slight variation is noticed in amplitude due to loading effects of the offset circuit. The baseline may be placed below ground if desired. The waveform obtained with this method is shown in Figure 3.





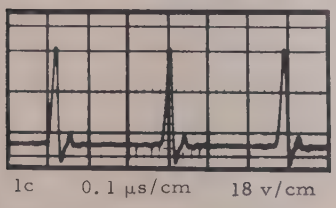
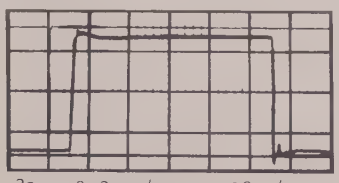
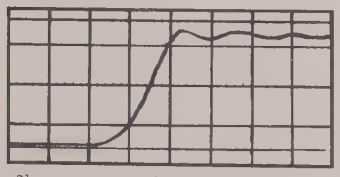


Figure 1. Pos. Pulse with Baseline +50mv Off Ground by Adjusting Output Bias.

(a) 1 µs Wide Pulse at 5 KC
(b) Leading Edge of (1a). Illustrates Rise Time.
(c) Positive Pulse at 3 MC.





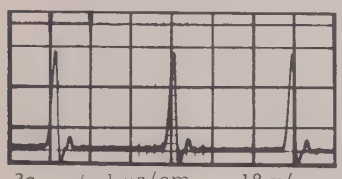
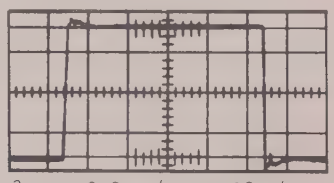
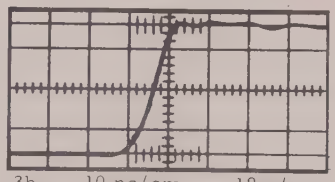


Figure 2. Pos. Pulse with Baseline +10mv Off Ground by Adjusting Output Bias.

(a) 1 µs Wide Pulse at 5 KC
(b) Leading Edge of (2a). Illustrates Rise Time
(c) Positive Pulse at 3 MC





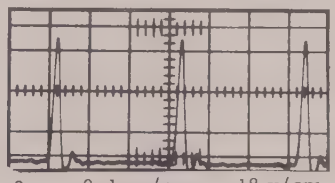


Figure 3. Pos. Pulse with Baseline Less Than 1mv Off Ground by Using DC Offset.

(a) 1 µs Wide Pulse at 5 KC
(b) Leading Edge of (3a). Illustrates Rise Time
(c) Positive Pulse at 3 MC

Photographs were taken from a Tektronix Type 581 Oscilloscope.

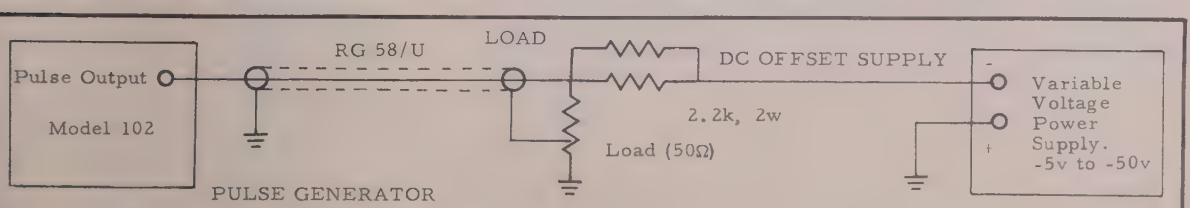


Figure 4. Wiring a DC Offset Supply for Variable Baseline Output of Datapulse Model 102. Baseline may be varied over a range of ±1 volt.

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DATAPULSE

APPLICATIONS BULLETIN

102-5

MODEL 102 ADVANCED PULSE OPERATION

The Model 102 pulse generator can be supplied as a Model 102Y, providing all features of standard operation, except that delay of the main pulse is variable from 0 to 10,000 μsec. with respect to the sync output (and the sync output is delayed from an external trigger if used by approximately 0.3 μsec.), plus providing pulse advance operation.

In the modified unit, a toggle switch is added to the front panel, labeled "Advance-Delay". In the delay position, the unit functions as a standard Model 102 with minor variations as described above. In the advance position, the instrument generates a main pulse at a fixed position (approximately 0.1 μsec. delay from an external trigger is used) and the delay controls provide the sync output variably delayed with respect to the leading edge of the main pulse over a range of 0 to 10,000 μsec.

This modification should be of particular interest in applications such as delay line testing or pulse network studies, where a controllable parameter pulse is delayed by the device under test, and it is desired to observe the output on a fast oscilloscope sweep by synchronizing the sweep at a controllable delay after generation of the input pulse.

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APPLICATIONS BULLETIN

102-6

MISCELLANEOUS MODIFICATION OF MODEL 102

DATAPULSE has recently quoted on Model 102 instruments modified as indicated below for various special applications. This information is passed on to all representatives as an indication of (1) the broad applications of the basic Model 102 (2) our willingness and ability to rapidly quote on minor modifications, and (3) as an indication of the type of modification which can be accomplished with the basic Model 102. The performance detailed is necessarily sketchy, and in some cases results in placing limitations on other specifications of the equipment. Proposal and/or quotation copies are available if anyone requires detailed information on one or more of the items listed.

ELEVATED BASELINE DC LEVEL:

For application in a satellite system ground support equipment test console, a 9v negative pulse was required from a baseline at a DC level of positive 9v. We quoted on a Model 102 modified by the addition of a cathode follower voltage source which, when mixed with the main pulse output through a coaxial mixer network, provided the required output. An applications bulletin is now in preparation detailing performance and equipment required for the general problem of providing output with baseline either to 0 volts DC or provided at a specified off-ground DC level.

DELAY GATE OUTPUT AND VARIABLE AMPLITUDE NEGATIVE SYNC

Customer had been utilizing an Electro-Pulse Model 2120A pulse generator in tests of digital modules. The standard Model 102 provided the required outputs, except that the sync output was desired at negative polarity and variable amplitude and an additional output was required with amplitude variable to 4 V positive or negative from a 5,000Ω source and with duration corresponding to delay of the main pulse output. By restricting the maximum repetition rate to 1 mc, the standard Model 102 power supplies were adequate to add a blocking oscillator stage driven by the standard sync output, but providing a variable amplitude negative sync. A second tube was added to provide the variable delay gate output required, driven from an existing waveform in the delay circuit.

TWIN PULSE OPERATION

Where requirements exist for two identical pulses in each cycle, variable in separation, the Model 102 may be modified by the addition of required circuitry and a front panel toggle switch which selects either standard or twin pulse operation. When operating in the twin pulse mode, the standard main pulse output is furnished in the normal fashion, in addition to which the main pulse width and output circuitry is triggered at sync pulse time. This provides the regular main pulse output, and on the same line, an identical pulse (with same rise time, polarity, and amplitude) on the main pulse output line with leading edge approximately 0.1 μsec. following the sync output. Separation between the pulses (trailing edge to leading edge) cannot be set to less than approximately 50% of the pulse width setting or 0.5 μsec., whichever is greater. Note that operation in the twin pulse mode is effectively limited to a basic repetition rate of somewhat above 1 mc. A standard model number 102X has been assigned to an instrument modified in this manner. In this connection, it should be noted that this modification provides an instrument essentially equivalent to the Electro-Pulse Model 3450D, in which this feature is offered as standard performance.

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DATA SYSTEMS • PULSE INSTRUMENTATION

DATAPULSE

APPLICATIONS BULLETIN

102-7

PULSE SHOCK TESTING
WITH MODEL 102 PULSE GENERATOR

Brimberg Associates, Washington, D. C. has recently sold a Model 102 Pulse Generator for application in conjunction with environmental shock testing. The customer was Texaco Experimental Station, Richmond, Virginia.

This most interesting application involves utilizing the pulse output of the Model 102 to drive a shake table power driver, thereby providing controlled duration and acceleration shocks.

The equipment is used at Texaco in conjunction with a Ling Model 219, 500 forcepound unit, frequency response DC to 6000 CPS, maximum acceleration 86 G's. At the same time the DATAPULSE unit was purchased, Texaco also purchased an Avco shock tester costing on the order of $7,000. They have since found that some 50% of their shock test work is accomplished with the Model 102 set-up. The advantages here are obvious, with shock testing run at the same time and on the same set-up as vibration testing, while freeing shock testing equipment for heavier jobs beyond the capability of the Model 102 product.

This application of the DATAPULSE Model 102 Pulse Generator should be of significant interest to all environmental test laboratories.

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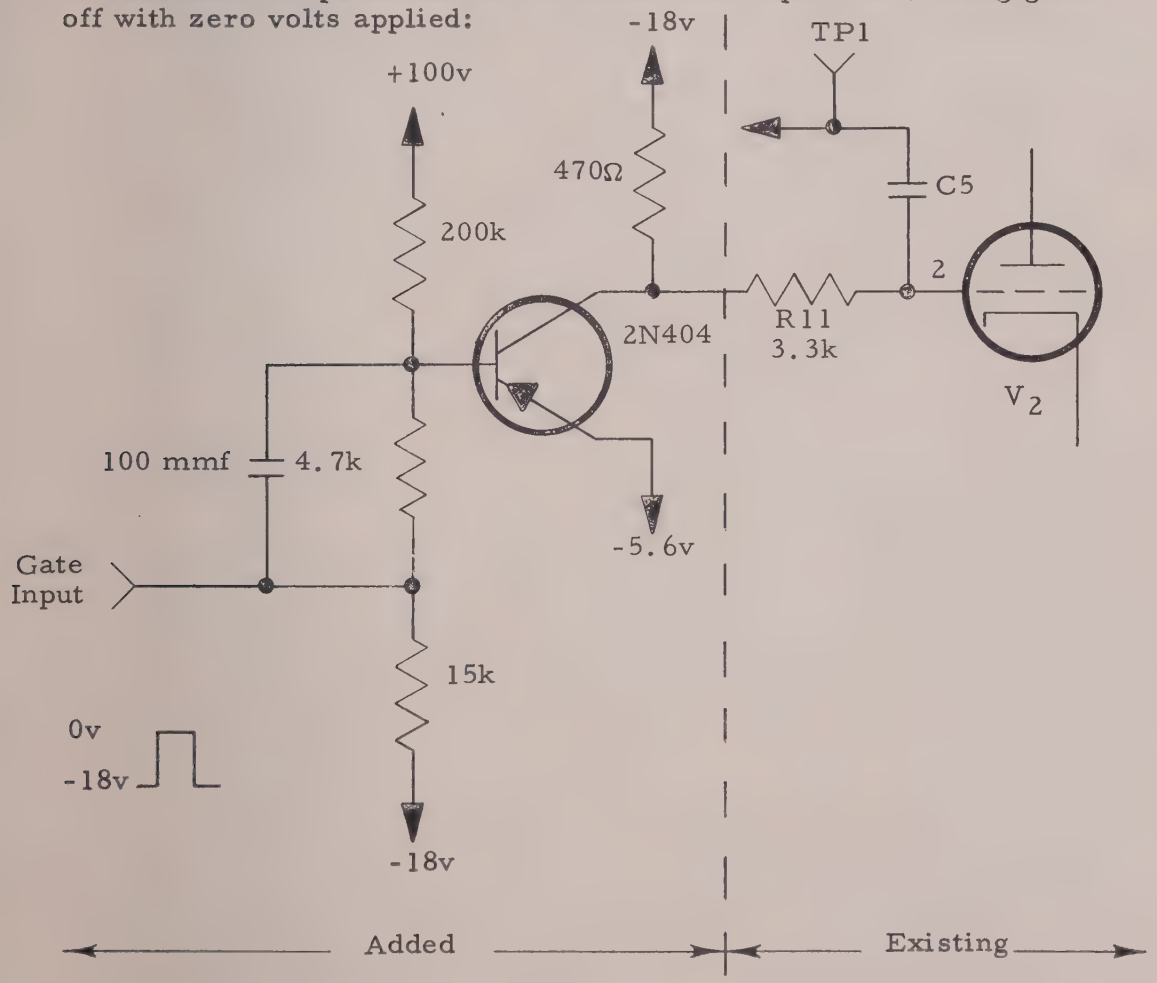
DATAPULSE

APPLICATIONS BULLETIN

102-10

MODEL 102 MODIFICATION FOR GATED OPERATION

In certain test applications it is desirable to place the output of a pulse generator under control of a gate signal. Addition of the following circuitry to the standard Model 102 Pulse Generator allows the instrument output to occur in the normal fashion with no connection or less than 18v presented to the added Gate Input Jack, being gated off with zero volts applied:



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DATA SYSTEMS • PULSE INSTRUMENTATION

DATAPULSE

SERVICE BULLETIN

NO. 102-1

DATAPULSE INCORPORATED, 525 MINOR AVE., INGLEWOOD 7, CALIF. ORCHARD 1-7719 • ORCHARD 8-7563

June 19, 1962

MODEL 102 PULSE GENERATOR
TUBE AND DIODE COMPLEMENT

The following listing of tubes and diodes utilized in the Model 102 pulse generator is furnished for guidance in the determination of required service spares stock:

Tubes	Diodes
2-0B2	1-1N1520
3-6AS7GA	3-1N2482
3-6AU6A	8-1N2483
8-6DJ8	3-1N2484
2-6DQ5	9-1N34A
2-6U8A	
1-12BH7A	
6-7119	

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DATAPULSE

SERVICE BULLETIN
NO. 102-2

August 24, 1962

VECTOR SOCKET FOR USE IN OVERLOAD ADJUSTMENT OF MODEL 102 PULSE GENERATOR

Page 26 of the first issue of the Instruction Manual for the Model 102 pulse generator refers to a Type T80C Vector socket in conjunction with the procedure for duty cycle overload adjustment of the instrument. This bulletin clarifies the specification and use of this accessory, available from most local electronic jobbers.

The Type T80C (Vector number) is an octal socket adapter designed to allow measurement of current through tube elements. Vector also has available a Type P1 probe which simplifies current measurement when used with this socket. The complete "tube socket test adapter kit" comprises one Type T80C adapter socket and one Type P1 probe, called out in combination as Vector No. T-789. When using during calibration of the 102 duty cycle overload adjustment, note that Model 102 tube No. V27 consists of two parallel triodes. This necessitates modification of the socket adapter in order to measure the total current through both halves of the tube. This is accomplished as follows:

1. Solder connect the inside contact of Pin 3 of the adapter socket to the inside contact of Pin 6.

2. Spread the set of contacts at Pin 3 of the adapter and insert a piece of insulation in such a manner as to keep the contacts separated.

The Vector Type P1 probe may now be inserted in the Pin 6 contacts, with the other end of the probe connected to the current meter for monitoring current through Tube V27, as required by the adjustment procedure in the instruction manual.

By J. E. Niebuhr

J. E. Niebuhr

Engineering Approval: R. Jack Johnson

R. Jack Johnson

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SERVICE BULLETIN
NO. 102-3

MODIFICATION OF MODEL 102 FOR ULTRA VERNIER RESOLUTION ON 0.5 μs DELAY RANGE

The standard Model 102 Pulse Generator, with its 1-2-5 series delay ranges, offers a resolution of less than 3% delay change per 5° rotation of the delay vernier control to satisfy all but the most critical requirements. Certain tests in the range of 150 to 500 nanosec delay, however, are more easily made with increased resolution. This bulletin details a modification to the standard Model 102 to provide essentially nanosecond resolution on the 0.5μsec delay range, as follows:

1. Remove R307 (150 ohm 5%) in shunt with R303A (500 ohm front section of potentiometer mounted on delay range switch).

2. Drill a 0.390 dia hole 1-9/16" below the Pulse Delay Switch horizontal axis on the same vertical axis.

3. Solder a white wire approximately 6 inches long to the counter clockwise terminal of a Chicago Telephone Supply Company Series VA45-6236 Potentiometer (150 ohm, 10 turn).

4. Solder a black wire approximately 6 inches long to the clockwise terminal of the potentiometer connecting the clockwise terminal to the arm in the process.

5. Install the potentiometer in the 0.390 dia hole previously drilled.

6. Solder the white wire to the counterclockwise terminal of R303A.

7. Solder the black wire to the clockwise terminal of R303A.

8. If desired, the added control may be labelled "0.5μs Delay Range Ultra-Vernier", with a CCW arrow labelled "Decrease Delay".

9. Indicate the above change on the instruction manual pulse delay switch schematic diagram (drawing D40000-002). Add to page 23 of the manual after the heading Pulse Delay Calibration " - Vernier and Ultra-Vernier fully CW". Add on page 31 (Verification of Specifications), at end of first line in para. 1 under Pulse Delay " - Ultra-Vernier fully CW".

The ultra-vernier control may now be utilized as a fine control, on the 0.5μsec delay range, to control delay with greatly increased resolution.

SUBJECT TO CHANGE WITHOUT

INSTRUMENT CERTIFICATION

Model 102 SN#_____

Instrument has been aged for 24 hours and fully calibrated prior to this test. _____

REPETITION RATE

Oscillator Covers 2 CPS to 3 MC _____

Accuracy ± 10% _____

No "Holes" in Vernier Coverage _____

Jitter ≤ 0.08% _____

EXTERNAL TRIGGER

20V RMS Drive Required from 200 CPS to 500 KC _____

+20V Pulse Drive Required from 0 CPS to 3 MC _____

SINGLE PULSE

Each depression of push button provides one cycle of output _____

SYNC PULSE

Amplitude > 20V open circuit
> 10V into 100 ohm at 3 MC _____

MAIN PULSE DELAY

Delay covers 0.2 μs to 10 MS _____

Accuracy ± 10% _____

No "Holes" in Vernier Coverage _____

Max duty cycle ≥ 70% _____

Jitter ≤ 0.05% _____

MAIN PULSE DURATION

Duration covers 0.05 μs to 10 MS _____

Accuracy ± 10% _____

No "Holes" in Vernier Coverage _____

Jitter ≤ 0.05% _____

MAIN PULSE OUTPUT

Amplitude ≥ 50V delivered into 50 ohm load (Positive and negative) _____

Attenuator Accuracy ± 10% _____

WAVEFORM

Overshoot variable to ≤ 4% _____

Rise time variable to 0.5 μs _____

Top slope variable to ≤ 3% (Less than 1 MS duration) _____

Rise time ≤ 10 nanoseconds. (Pos. & Neg.) _____

Decay time ≤ 10 nanoseconds. (Pos. & Neg.) _____

AVERAGE PULSE CURRENT OVERLOAD

Circuit limits average pulse current at 225 ma _____

Average pulse current overload lamp lights at 200 ma _____

R136 (Overload Indicator Adj.) & R135 (Overload Adj.) sealed with red glyptol. _____

I certify that this instrument meets all the above specifications and conforms to DATAPULSE Standard 91200-000 for workmanship and appearance.

Q. C. ACCEPTANCE	
INSPECTOR	DATE

SIGNED_____
Final Test Inspector

DATE_____

WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.

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